SC361
.257t
746

NOAA Technical Report NMFS SSRF - 746

Distribution of Gammaridean Amphipoda (Crustacea) on Georges Bank

John J. Dickinson and Roland L. Wigley

June 1981

LIBRARY

JUL 27 1981

National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA TECHNICAL REPORTS

National Marine Fisheries Service, Special Scientific Report—Fisheries

The major responsibilities of the National Marine Fisheries Service (NMFS) are to monitor and assess the abundance and geographic distribution of fishery resources, to understand and predict fluctuations in the quantity and distribution of these resources, and to establish levels for optimum use of the resources. NMFS is also charged with the development and implementation of policies for managing national fishing grounds, development and enforcement of domestic fisheries regulations, surveillance of foreign fishing off United States coastal waters, and the development and enforcement of international fishery agreements and policies. NMFS also assists the fishing industry through marketing service and economic analysis programs, and mortgage insurance and vessel construction subsidies. It collects, analyzes, and publishes statistics on various phases of the industry.

The Special Scientific Report—Fisheries series was established in 1949. The series carries reports on scientific investigations that document long-term continuing programs of NMFS, or intensive scientific reports on studies of restricted scope. The reports may deal with applied fishery problems. The series is also used as a medium for the publication of bibliographies of a specialized scientific nature.

NOAA Technical Reports NMFS SSRF are available free in limited numbers to governmental agencies, both Federal and State. They are also available in exchange for other scientific and technical publications in the marine sciences. Individual copies may be obtained (unless otherwise noted) from D822, User Services Branch, Environmental Science Information Center, NOAA, Rockville, MD 20852. Recent SSRF's are:

722. Gulf menhaden, *Brevoortia patronus*, purse seine fishery: Catch, fishing activity, and age and size composition, 1964–73. By William R. Nicholson. March 1978, iii + 8 p., 1 fig., 12 tables.

723. Ichthyoplankton composition and plankton volumes from inland coastal waters of southeastern Alaska, April–November 1972. By Chester R. Mattson and Bruce L. Wing. April 1978, iii + 11 p., 1 fig., 4 tables.

724. Estimated average daily instantaneous numbers of recreational and commercial fishermen and boaters in the St. Andrew Bay system, Florida, and adjacent coastal waters, 1973. By Doyle F. Sutherland. May 1978, iv + 23 p., 31 figs., 11 tables.

725. Seasonal bottom-water temperature trends in the Gulf of Maine and on Georges Bank, 1963–75. By Clarence W. Davis. May 1978, iv + 17 p., 22 figs., 5 tables.

726. The Gulf of Maine temperature structure between Bar Harbor, Maine, and Yarmouth, Nova Scotia, June 1975–November 1976. By Robert J. Pawlowski. December 1978, iii + 10 p., 14 figs., 1 table.

727. Expendable bathythermograph observations from the NMFS/MARAD Ship of Opportunity Program for 1975. By Steven K. Cook, Barclay P. Collins, and Christine S. Carty. January 1979, iv + 93 p., 2 figs., 13 tables, 54 app. figs.

728. Vertical sections of semimonthly mean temperature on the San Francisco-Honolulu route: From expendable bathythermograph observations, June 1966–December 1974. By J. F. T. Saur, L. E. Eber, D. R. McLain, and C. E. Dorman. January 1979, iii + 35 p., 4 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00438-4.

729. References for the identification of marine invertebrates on the southern Atlantic coast of the United States. By Richard E. Dowds. April 1979, iv + 37 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00454-6.

730. Surface circulation in the northwestern Gulf of Mexico as deduced from drift bottles. By Robert F. Temple and John A. Martin. May 1979, iii + 13 p., 8 figs., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00456-2.

731. Annotated bibliography and subject index on the shortnose sturgeon, *Acipenser brevirostrum*. By James G. Hoff. April 1979, iii + 16 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00452-0.

732. Assessment of the Northwest Atlantic mackerel, *Scomber scombrus*, stock. By Emory D. Anderson. April 1979, iv + 13 p., 9 figs., 15 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00450-3.

733. Possible management procedures for increasing production of sockeye salmon smolts in the Naknek River system, Bristol Bay, Alaska. By Robert J. Ellis and William J. McNeil. April 1979, iii + 9 p., 4 figs., 11 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00451-1.

734. Escape of king crab, *Paralithodes camtschatica*, from derelict pots. By William L. High and Donald D. Worlund. May 1979, iii + 11 p., 5 figs., 6 tables.

735. History of the fishery and summary statistics of the sockeye salmon, *Oncorhynchus nerka*, runs to the Chignik Lakes, Alaska, 1888–1966. By Michael L. Dahlberg. August 1979, iv + 16 p., 15 figs., 11 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00459-7.

736. A historical and descriptive account of Pacific coast anadromous salmonid rearing facilities and a summary of their releases by region, 1960–76. By Roy J. Whale and Robert Z. Smith. September 1979, iv + 40 p., 15 figs., 25 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00460-1.

737. Movements of pelagic dolphins (*Stenella* spp.) in the eastern tropical Pacific as indicated by results of tagging, with summary of tagging operations, 1969–76. By W. F. Perrin, W. E. Evans, and D. B. Holts. September 1979, iii + 14 p., 9 figs., 8 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00462-7.

738. Environmental baselines in Long Island Sound, 1972–73. By R. N. Reid, A. B. Frame, and A. F. Draxler. December 1979, iv + 31 p., 40 figs., 6 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00466-0.

739. Bottom-water temperature trends in the Middle Atlantic Bight during spring and autumn, 1964–76. By Clarence W. Davis. December 1979, iii + 13 p., 10 figs., 9 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 003-017-00467-8.

NOAA Technical Report NMFS SSRF - 746

Distribution of Gammaridean Amphipoda (Crustacea) on Georges Bank

John J. Dickinson and Roland L. Wigley

June 1981

U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and Atmospheric Administration

National Marine Fisheries Service
Terry L. Leitzell, Assistant Administrator for Fisheries

The National Marine Fisheries Service (NMFS) does not approve, recommend or endorse any proprietary product or proprietary material mentioned in this publication. No reference shall be made to NMFS, or to this publication furnished by NMFS, in any advertising or sales promotion which would indicate or imply that NMFS approves, recommends or endorses any proprietary product or proprietary material mentioned herein, or which has as its purpose an intent to cause directly or indirectly the advertised product to be used or purchased because of this NMFS publication.

CONTENTS

Introduction 1
Georges Bank—description of environment 1
Georges Bank—Amphipoda 1
Methods 1
Annotated list of species 2
Discussion 7
  Zoogeography 7
  Species distribution patterns 7
    Northeast Peak 7
    Perimeter 8
    Western Basin 8
    Shoals 8
    Southern Edge 8
    Central 8
Acknowledgments 8
Literature cited 8

Table

1. Six patterns of gammaridean distribution on Georges Bank 7

Figures

1. Geographical features and bathymetry of Georges Bank 10
2. Geographic distribution of bottom sediment types and station locations on Georges Bank 11
3. Distribution of average bottom-water temperatures during February and September on Georges Bank 12

Geographic distribution of species of gammaridean Amphipoda on Georges Bank:

4. *Acanthohaustorius intermedius, A. spinosus, A. similis, A.* sp. C, *A.* sp. D, *Acanthonotozoma serratum, Andaniopsis nordlandica, Ampelisca agassizi* 13
5. *Ampelisca declivitatis, A. macrocephala, A. vadorum, Amphilochoides odontyx, Amphiporeia gigantea, A. virginiana, Amphithoe rubricata, Anonyx debruyni, A. sarsi, A. liljeborgi* 14
6. *Argissa hamatipes, Bathymedon sausserei, Bathyporeia quoddyensis, Byblis gaimardi, B. serrata, Calliopius laeviusculus, Casco bigelowi, Corophium crassicorne* 15
7. *Dulichia tuberculata, Dyopedos arcticus, D. monacantha, Epimeria loricata, Ericthonius rubricornis, Eriopisa elongata, Eusirus cuspidatus, Gammaropsis maculatus, Gammarus annulatus* 16
8. *Gitanopsis arctica, Halice abyssi, Halirages fulvocinctus, Haliragoides inermis, Haploops tubicola, Harpinia propinqua, Hippomedon propinquus* 17
9. *Hippomedon serratus, Ischyrocerus anguipes, I. megacheir, Leptocheirus pinguis, Melita dentata, Maera danae, Melita* sp. A, *M.* sp. B, *Melphidippa goesi* 18
10. *Monoculodes edwardsi, M. intermedius, M. latimanus, Monoculopsis longicornis, Neopleustes pulchellus, Orchomene minuta, O. pinguis, Paradulichia typica* 19
11. *Parahaustorius attenuatus, P. holmesi, P. longimerus, Paraphoxus epistomus, Pardalisca cuspidata, Photis dentata, P. macrocoxa, Phoxocephalus holbolli* 20
12. *Platyishnopus* sp. A, *Pleusymtes glaber, Pleustes panoplus, Podoceropsis nitida, Pontogeneia inermis, Protohaustorius deichmannae, P. wigleyi* 21
13. *Protomedeia fasciata, Psammonyx nobilis, Pseudohaustorius borealis, Pseudunciola obliquua, Rhachotropis distincta, R. inflata, R. oculata* 22
14. *Siphonoecetes smithianus, Stegocephalus inflatus, Stenopleustes gracilis, S. inermis, Stenothoe minuta, Stenula peltata, Synchelidium americanum, Syrrhoe crenulata, Tiron spiniferum* 23
15. *Tmetonyx cicada, Tryphosella nanoides, Unciola dissimilis, U. inermis, U. irrorata, U. spicata, Westwoodilla megalops* 24
16. Most common distribution patterns of gammarideans on Georges Bank 25

Distribution of Gammaridean Amphipoda (Crustacea) on Georges Bank

JOHN J. DICKINSON[1] and ROLAND L. WIGLEY[2]

ABSTRACT

The distribution of 97 species of gammaridean amphipods is described for the Georges Bank region, based on 379 samples from 326 stations. A wide variety of sampling gear was used, resulting in representation of both infaunal and epifaunal species. Geographic and bathymetric distributions, and sediment preferences are summarized for each species. The zoogeography of the gammaridean fauna of Georges Bank is discussed, and the most common geographic distribution patterns are described and related to environmental parameters.

INTRODUCTION

This report describes distribution patterns for 97 species of gammaridean amphipoda on Georges Bank. Georges Bank is a submerged coastal plain that extends over 300 km east of Cape Cod, Mass., and encompasses an area of approximately 19,000 km² (Fig. 1). It is one of the most productive fishing grounds in the world yielding thousands of metric tons of finfish and shellfish annually (Gusey 1977). In the future, Georges Bank might also serve as an offshore source of petroleum.

Gammaridean amphipoda are the most numerous group of macroinfaunal organisms inhabiting Georges Bank, composing 49% of the number of specimens in quantitative samples collected there (Wigley and Theroux in prep.). Gammarideans are important food for many juvenile bottom-feeding fish. They often comprise 30% or more of the diet (Bowman[3]).

The purpose of this report is to provide information useful to both benthic ecologists and fisheries biologists interested in the Georges Bank ecosystem. Since amphipods are known to be sensitive to environmental alteration, the data presented in this report may also be useful as a baseline in the event of petroleum development on Georges Bank.

GEORGES BANK—DESCRIPTION OF ENVIRONMENT

For purposes of this report, we define Georges Bank as that part of the New England continental shelf between Great South Channel (long. 69°W) and Northeast Channel at water depths <200 m (Fig. 1A). The important physiographic features of Georges Bank include: 1) a steeply sloping northern face; 2) an area of shoals in the north-central part; 3) a gently sloping southern face (Fig. 1B). The bank has been shaped by glacial erosion in the past, and recently by the strong tidal currents that run through the shoals (Stewart and Jordan 1964). The sediments of Georges Bank are dominated by sands (Wigley 1961). The central area of the bank including the shoals is chiefly medium to coarse sand (Fig. 2A). Gravel covers the Northeast Peak, but fine sands occur around most of the perimeter of the bank. Silts, clays, and fine sands are the dominant components in the Western Basin.

Bottom water temperatures on Georges Bank vary a moderate amount during the year usually reaching a maximum in September and a minimum in February (Colton and Stoddard 1973). The greatest seasonal changes occur in the shallow central area of the bank which experiences about a 12 °C annual fluctuation ranging from 4° to 16 °C (Fig. 3A, B). The perimeter of the bank has a much smaller annual temperature range fluctuating as little as 2 °C in some areas. The coldest year-round bottom waters (6°–8 °C) occur in the Western Basin and on the Northeast Peak.

GEORGES BANK—AMPHIPODA

The gammaridean amphipod fauna of Georges Bank has been little studied previously. Smith and Harger (1874) collected a few samples from the bank and reported the amphipods which they found, but the taxonomy is now outdated and coverage of the bank was incomplete. Some records of occurrence on Georges Bank are given in papers of Shoemaker (1945b) and Bousfield (1965). Whitely (1948) collected 42 species of epibenthic and pelagic gammarideans on Georges Bank, but he gave distributional data for only one species, *Monoculodes edwardsi.*

METHODS

The distribution patterns described in this report are based on samples collected by the Benthic Dynamics Investigation at the Northeast Fisheries Center at Woods Hole, Mass. These collections were obtained as part of a survey, conducted between 1953 and 1965, to obtain an overview of the general composition and distribution of the macrobenthos on the continental shelf between Nova Scotia and Florida.

A total of 379 collections from 326 stations were utilized in charting the distribution of gammarideans on Georges Bank (Fig. 2B). The coverage of the bank was relatively complete except for the Shoals area where fewer samples were taken due to the hazards of navigating there. The samples were collected with a variety of sampling gear, including 1) quantitative grabs (Van Veen, Smith-Mac Intyre, Campbell), 2) epibenthic sled nets (ring and meter), 3) Dibby dredges, 4) otter trawls, and 5) from fish stomachs. The Smith-Mac Intyre grab (160 samples), the ring net (85), and the meter net (50) were the most frequently

[1]Northeast Fisheries Center Woods Hole Laboratory, National Marine Fisheries Service, NOAA, Woods Hole, Mass.; present address: National Museum of Canada, Ottawa K1A OM8, Canada.

[2]Northeast Fisheries Center Woods Hole Laboratory, National Marine Fisheries Service, NOAA, Woods Hole, MA 02543.

[3]Raymond Bowman, Fisheries Biologist, Northeast Fisheries Center Woods Hole Laboratory, National Marine Fisheries Service, NOAA, Woods Hole, MA 02543, pers. commun. December 1979.

used samplers. Due to the variety of gear used and the large number of samples collected, we feel that a representative species list was obtained of both infaunal and epifaunal amphipods. Estimates of numerical density given in this report were based on samples collected with either the Smith-Mac Intyre (0.1 m^2) or the Campbell (0.56 m^2) grabs.

Nearly all the gammaridean species that we collected on Georges Bank are described in previous taxonomic works. Bousfield's (1973) excellent systematic monograph on the shallow-water amphipod fauna of New England described about one-half of the species found on the bank. The next most important reference is Sars (1895) classic work on the Crustacea of Norway, which includes about one-third of the species occurring on Georges Bank. Other useful systematic references include Holmes (1905), Shoemaker (1930a, b, 1945a, b), Stephensen (1935, 1938, 1940, 1942), Gurjanova (1951), Barnard (1960, 1969, 1971, 1972, 1979), Bousfield (1965, 1970, 1977, 1978), Mills (1967, 1971), and Laubitz (1977). The species names used in this report primarily follow Bousfield (1973), but recent revisions by Barnard (1969) and Laubitz (1977) have been incorporated. The systematic arrangement of species into families and superfamilies follows the phylogenetic classification proposed by Bousfield (1978).

ANNOTATED LIST OF SPECIES

The following list gives a summary of the geographic and bathymetric ranges and sediment preference for each species based on literature sources. Notes on general ecology are also included when information was available. The distribution of each species on Georges Bank is also characterized based on our collections, and a series of charts (Figs. 4-15) show the patterns of occurrence for each species collected. These charts are arranged alphabetically according to the species names.

Class Crustacea
Subclass Malacostraca
Superorder Peracarida
Order Amphipoda
Suborder Gammaridea

Superfamily Phoxocephaloidea
Family Phoxocephaidae

Harpinia propinqua G.O. Sars, 1895. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to Cape Hatteras; 10-1,500 m, sand to silt-clay bottoms, burrowing detritivore (Sars 1895; Bousfield 1973; Dickinson et al. 1980).

Perimeter of Georges Bank, 84-196 m, gravel to silt-clay bottoms, 4.5°–7.7°C, densities 10–50/m^2.

Phoxocephalus holbolli Kroyer, 1842. Arctic-Boreal in North Atlantic; in western Atlantic: Arctic south to Virginia; 0-400 m, sand and silty sand bottoms, burrowing detritivore (Bousfield 1973; Dickinson et al. 1980) m^2.

Perimeter of Georges Bank, 33-179 m, sand and gravelly sand bottoms, 7.1°–12.3°C, densities 10-100/m^2.

Paraphoxus epistomus (Shoemaker, 1938). (*Trichophoxus epistomus* in Bousfield 1973. See Barnard 1979 for most recent discussion and proposal to change name to *Rhepoxynius epistomus*.) Boreal regions of North Atlantic and North Pacific; in western Atlantic: Maine south to North Carolina; 0-180 m, sand bottoms, burrowing detritivore (Barnard 1960; Bousfield 1973; Dickinson et al. 1980).

Central Georges Bank, 33–123 m, gravel and sand bottoms, 5.4°–12.3°C, densities 10–150/m^2.

Family Platyishnopidae.

Platyishnopus sp. A (undescribed species). Southern edge of Georges Bank, 121 m, sand bottom, 7.5°C. This species will be described by E. L. Bousfield of the Canadian National Museum in Ottawa.

Superfamily Lysianassoidea
Family Lysianassidae

Anonyx debruyni Hoek, 1882. Arctic waters of North Atlantic; in western Atlantic: south from Gulf of St. Lawrence to Cape Cod; bathyal depths and cold water (Steele and Brunel 1968).

Western Basin of Georges Bank, 183 m, silt-clay bottoms, 6.6°C.

Anonyx liljeborgi Boeck, 1871. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to Delaware; 0–200 m, sand and silty sand bottoms, epibenthic scavenger (Steele and Brunel 1968; Bousfield 1973).

Perimeter of Georges Bank, 60–183 m, sand and silt-clay bottoms, 6.6°–11.6°C.

Anonyx sarsi Steele and Brunel, 1968. Circumpolar; in western Atlantic: Arctic south to New Jersey; 0–65 m, sand bottoms, epibenthic scavenger (Steele and Brunel 1968; Bousfield 1973).

Southern edge and Northeast Peak of Georges Bank, 70-97 m, gravel to sand bottoms, 7.4°–7.7°C.

Hippomedon propinquus Sars, 1895. Boreal regions of North Atlantic; in western Atlantic: from Nova Scotia south to Cape Hatteras; 15–250 m, gravelly sand to silt-clay bottoms, epibenthic (Sars 1895; Dickinson et al. 1980).

Western Basin and perimeter of Georges Bank, 73–196 m, sand to silt-clay bottoms, 6.6°–11.6°C.

Hippomedon serratus Holmes, 1905. Western Atlantic: Gulf of St. Lawrence south to North Carolina; 5–90 m, sand and silty sand, epibenthic (Bousfield 1973; Dickinson et al. 1980).

Southern Georges Bank, 35–106 m, sand and gravel bottoms, 7.3°–11.6°C.

Orchomene minuta Krøyer, 1846. Arctic-Boreal regions of North Atlantic; in western Atlantic: south from Baffin Island to New Jersey; 0–100 m, sand bottoms, epibenthic (Bousfield 1973; Dickinson et al. 1980).

Southern Georges Bank and Northeast Peak, 48–179 m, sand and gravelly sand bottoms, 7.4°–11.6°C, densities 10–100/m^2.

Orchomene pinguis Boeck, 1861. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to North Carolina; 0–100 m, sand bottoms, epibenthic scavenger (Stephensen 1938; Bousfield 1973).

Perimeter of Georges Bank, 60–168 m, sand and silt-clay bottoms, 6.6°–11.2°C.

Psammonyx nobilis Stimpson, 1853. Western Atlantic: Newfoundland to New Jersey; 0–60 m, sand bottoms, burrower (Scott and Croker 1976; Dickinson et al. 1980).

Northern Georges Bank, 22–128 m, sand and gravelly sand, 6.1°–9.3°C.

Tmetonyx cicada O. Fabricius, 1780. Boreal-Arctic regions of North Atlantic; in western Atlantic: Arctic south to New Jersey; 0–2,000 m, sand and silty sand bottoms, epibenthic scavenger (Sars 1895; Stephensen 1935).

Perimeter of Georges Bank, 91–183 m, sand and silt-clay bottoms, 6.3°–7.6°C.

Tryphosella nanoides Liljeborg, 1865. Eastern North Atlantic; not previously reported from western Atlantic; 100–700 m (Sars 1895; Stephensen 1935).

Northern edge of Georges Bank, 179 m, sand bottom, 7.8°C.

Superfamily Pontoporeioidea

Family Pontoporeiidae

Amphiporeia gigantea Bousfield, 1973. Western Atlantic: Cape Cod south to New Jersey; 10–40 m, sand bottoms, burrowing detritivore (Bousfield 1973; Glennon 1979).

Central Georges Bank, 20–55 m, sand bottom, 7.8°–9.4°C.

Amphiporeia virginiana Shoemaker, 1933. Western Atlantic: Nova Scotia south to South Carolina; 0–15 m, sand bottoms, burrowing detritivore (Bousfield 1973; Hager and Croker 1979).

Central Georges Bank, 33 m, sand bottom, 8.4°C.

Bathyporeia quoddyensis Shoemaker, 1949. Western Atlantic: Nova Scotia south to Virginia; sand bottoms, burrowing detritivore (Bousfield 1973).

Central Georges Bank, 33–66 m, sand bottom, 7.6°C.

Family Haustoriidae

Acanthohaustorius intermedius Bousfield, 1965. Western Atlantic: Cape Cod to Florida; 0–40 m, sand bottoms, burrowing filter feeder (Bousfield 1973; Dickinson et al. 1980).

Central Georges Bank, 33–66 m, sand bottom.

Acanthohaustorius similis Frame, 1980. Western Atlantic: Cape Cod south to Cape Hatteras; 10–74 m, sand bottoms, burrowing filter feeder (Dickinson et al. 1980; Frame 1980).

Central Georges Bank, 33–66 m, sand bottom.

Acanthohaustorius spinosus Bousfield, 1962. Western Atlantic: Nova Scotia to New Jersey; 0–200 m, sand bottoms, burrowing filter feeder (Bousfield 1973).

Central Georges Bank, 64 m, sand bottom.

Acanthohaustorius sp. C (undescribed species). Western Atlantic: Cape Cod to Cape Hatteras; 10–40 m, sand bottoms (Dickinson et al. 1980).

Central Georges Bank, 46–49 m, sand bottom.

Acanthohaustorius sp. D (undescribed species). Central and Southern Georges Bank, 46–82 m, sand bottoms.

Parahaustorius attenuatus Bousfield, 1965. Western Atlantic: Cape Cod south to Virginia; 0–75 m, sand bottoms, burrowing filter feeder (Bousfield 1965, 1973; Dickinson et al. 1980).

Central Georges Bank, 33–66 m, sand bottom.

Parahaustorius holmesi Bousfield, 1965. Western Atlantic: Cape Cod to Virginia; 20–50 m, sand bottoms, burrowing filter feeder (Bousfield 1965, 1973).

Central Georges Bank, 35–42 m, sand bottom, 13.4°C.

Parahaustorius longimerus Bousfield, 1965. Western Atlantic: Cape Cod Bay south to northern Florida; 0–10 m, sand bottoms, burrowing filter feeder (Bousfield 1965, 1973; Croker 1967).

Central Georges Bank, 20–66 m, sand bottom.

Protohaustorius deichmannae Bousfield, 1965. Western Atlantic: Maine to South Carolina; 0–40 m, sand, shelly sand, and silty sand bottoms, burrowing filter feeder (Bousfield 1965, 1973; Dickinson et al. 1980).

Central Georges Bank, 46–60 m, sand bottom.

Protohaustorius wigleyi Bousfield, 1965. Western Atlantic: Maine to North Carolina; 0–150 m, shell and sand bottoms, burrowing filter feeder (Bousfield 1965, 1973; Dickinson et al. 1980).

Central and southern Georges Bank, 33–95 m, sand and gravelly sand bottoms, 7.6°–12.3°C, densities 10–300/m².

Pseudohaustorius borealis Bousfield, 1965. Western Atlantic: Georges Bank to Virginia; 10–60 m, sand bottoms, burrowing filter feeder (Bousfield 1965, 1973; Dickinson et al. 1980).

Central and northern Georges Bank, 46–88 m, sand bottoms.

Superfamily Gammaroidea

Family Gammaridae

Gammarus annulatus Smith, 1873. Western Atlantic: Nova Scotia to Long Island Sound; 0–200 m, sand bottoms, epibenthic or pelagic, omnivore (Bousfield 1973; Dickinson et al. 1980).

Southwest Georges Bank, 123 m, sand bottom. (It is noteworthy that this species, which reaches densities of 600/m² on Nantucket Shoals (Dickinson et al. 1980), was represented by only a single specimen on Georges Bank.)

Superfamily Eusiroidea

Family Eusiridae

Eusirus cuspidatus Krøyer, 1845. Arctic Atlantic; in western Atlantic: Arctic south to Bay of Fundy; 40–400 m, epibenthic or pelagic, probably carnivorous (Sars 1895; Stephensen 1935).

Western Basin of Georges Bank, 183 m, silt bottom, 6.6°C.

Rhachotropis distincta (Holmes, 1908). Arctic-Boreal regions of North Pacific and North Atlantic; in western Atlantic: Arctic south to Gulf of St. Lawrence, 300-1,200 m, epibenthic carnivore (Barnard 1971; Bousfield 1973).

Western Basin of Georges Bank (southern range extension), 157–196 m, silt-clay bottoms, 6.6°–7.7°C.

Rhachotropis inflata (G. O. Sars, 1882). Boreal regions of North Pacific and North Atlantic; in western Atlantic: Arctic south to Virginia; 20–100 m, epibenthic carnivore (Barnard 1971; Dickinson et al. 1980).

Southern edge of Georges Bank, 72–144 m, sand and gravel bottoms, 7.2°–12.6°C.

Rhachotropis oculata (Hansen, 1887). Pan-Arctic and Arctic-Boreal; in western Atlantic: Greenland south to Cape Cod; 5–100 m, epibenthic and pelagic carnivore (Bousfield 1973).

Southeast Georges Bank, 82–95 m, sand bottom.

Family Pontogeneiidae

Pontogeneia inermis (Krøyer, 1842). Arctic-Boreal in North Atlantic and North Pacific; in western Atlantic: Arctic south to Virginia; 0–80 m, rocky bottoms, epibenthic and pelagic (Bousfield 1973; Dickinson et al. 1980).

Central Georges Bank, 20–179 m, gravel to sand bottoms, 7.0°–11.3°C.

Family Calliopiidae

Calliopius laeviusculus (Krøyer, 1838). Arctic-Boreal in North Atlantic and North Pacific; in western Atlantic: Labrador south to New Jersey; 0–30 m, rock and gravelly

sand bottoms, 0°–22 °C, pelagic and epibenthic carnivore (Bousfield 1973; Steele and Steele 1973).

Central part of Georges Bank, 20–59 m, sand bottom, 7.6°–11.1 °C.

Halirages fulvocinctus (M. Sars, 1854). Circumpolar Arctic; in western Atlantic: Arctic south to New England coast; 10–400 m, gravel and clay bottoms, epibenthic (Sars 1895; Stephensen 1938).

Western Basin of Georges Bank, 157–183 m, silt-clay bottom, 6.6°–6.8 °C.

Haliragoides inermis (G. O. Sars, 1882). Arctic-Atlantic; in western Atlantic: Arctic south to Gulf of St. Lawrence; 30–2,000 m, silt-clay bottoms, epibenthic (Sars 1895; Stephensen 1938).

Western Basin and Northern Edge of Georges Bank (southern range extension), 152–196 m, gravel to silt-clay bottoms, 6.6°–7.7 °C.

Family Paramphithoidae

Epimeria loricata G. O. Sars, 1879. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic to New Jersey; 150–1,400 m, mud bottoms (Sars 1895; Stephensen 1938; Watling 1979).

Western Basin and Northern Edge of Georges Bank, 157–183 m, sand and silt-clay bottoms, 6.6°–7.6 °C.

Superfamily Oedicerotoidea

Family Oedicerotidae

Bathymedon sausserei (Boeck, 1871). Boreal North Atlantic; not previously recorded in western Atlantic; 100–600 m, burrowing detritivore (Sars 1895; Stephensen 1938).

Western Basin and Northern Edge of Georges Bank (first western Atlantic records), 154–179 m, sand bottoms, 7.6 °C.

Monoculodes edwardsi Holmes, 1908. Western Atlantic: Gulf of St. Lawrence south to Florida; 0–80 m, sand bottoms, burrowing detritivore (Bousfield 1973; Dickinson et al. 1980).

Central Georges Bank, 20–179 m, sand and gravel bottoms, 7.1°–12.6 °C, most abundant species in epibenthic collections.

Monoculodes intermedius Shoemaker, 1930. Boreal regions of North Atlantic; in western Atlantic: Gulf of St. Lawrence south to Cape Cod Bay; 5–50 m, sand bottoms, burrowing detritivore (Bousfield 1973).

Northeast Peak of Georges Bank, 101 m, gravel bottom, 8.2 °C.

Monoculodes latimanus (Goes, 1866). Boreo-Arctic regions of North Atlantic; in western Atlantic: Arctic south to Gulf of St. Lawrence; 5–100 m, burrowing detritivore (Sars 1895; Stephensen 1938; Bousfield 1973).

Southern Georges Bank, 84 m, gravel bottom.

Monoculopsis longicornis (Boeck, 1871). Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to Gulf of St. Lawrence; 0–100 m, sand and mud bottoms, burrowing detritivore (Sars 1895; Stephensen 1938).

Northern Edge of Georges Bank (southern range extension), 156–168 m, sand bottom.

Synchelidium americanum Bousfield, 1973. Western Atlantic: Central Maine to Georgia; 0–40 m, sand bottoms, burrowing detritivore (Bousfield 1973; Dickinson et al. 1980).

Southern Georges Bank, 73–84 m, sand and gravel bottoms, 10.5 °C.

Westwoodilla megalops (G. O. Sars, 1882). Arctic-Boreal regions of North Atlantic and Arctic Oceans; in western Atlantic: Arctic south to Gulf of St. Lawrence; 10–90 m, burrowing detritivore (Sars 1895; Stephensen 1938).

Northeast Peak of Georges Bank (southern range extension), 192 m, sand bottom.

Superfamily Leucothoidea

Family Pleustidae

Neopleustes pulchellus Krøyer, 1846. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to Georges Bank; 40–800 m, rock and gravel bottoms, epibenthic (Sars 1895; Stephensen 1938; Bousfield 1973).

Northeast Peak of Georges Bank, 84–108 m, gravel bottom.

Pleustes panoplus Krøyer, 1838. Circumpolar; in western Atlantic: Arctic south to New England coast; 10–280 m, sand and gravel bottoms, epibenthic (Sars 1895; Stephensen 1938).

Southern Georges Bank and Northeast Peak, 71–103 m, gravel to sand bottoms, 7.2°–7.7 °C.

Pleusymtes glaber Boeck, 1861. Boreal regions of North Atlantic; in western Atlantic: Labrador to Chesapeake Bay; 5–120 m, rocky bottoms (Gurjanova 1951; Bousfield 1973).

Great South Channel and Northeast Peak of Georges Bank, 48–146 m, sand and gravel bottoms, 7.4°–8.9 °C.

Stenopleustes gracilis Holmes, 1905. Western Atlantic: Cape Cod south to Chesapeake Bay, 5–50 m, sand bottoms (Bousfield 1973; Dickinson et al. 1980).

Great South Channel and Northeast Peak of Georges Bank, 58–103 m, sand and gravel bottoms, 7.1°–8.4 °C.

Stenopleustes inermis Shoemaker, 1949. Western Atlantic: Gulf of Maine south to Delaware Bay; 5–100 m, sand and silty sand bottoms, epibenthic (Bousfield 1973; Dickinson et al. 1980).

Southern Georges Bank, 66–95 m, sand bottom.

Family Amphilochidae

Amphilochoides odontyx (Boeck, 1871). Boreal regions of North Atlantic; in western Atlantic: Arctic south to New Jersey; 20–120 m, sand to silt-clay bottoms (Sars 1895; Stephensen 1938; Watling 1979).

Southern Georges Bank, 84 m, gravel bottom, 10.4 °C.

Gitanopsis arctica G. O. Sars, 1895. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to Gulf of St. Lawrence; 10–100 m, silt-clay bottoms (Sars 1895; Stephensen 1938).

Northern Edge of Georges Bank (southernmost record in western Atlantic), 64 m.

Family Stenothoidae

Stenothoe minuta Holmes, 1905. Western Atlantic: Cape Cod south to Georgia; 0–40 m, usually associated with hydroids and bryozoans (Bousfield 1973).

Southern Georges Bank, 64–73 m, sand bottom.

Stenula peltata (Smith, 1873). Western Atlantic: Arctic to Gulf of St. Lawrence; 50–200 m (Gosner 1971; Bousfield 1973).

Perimeter of Georges Bank, 70–179 m, sand.

Superfamily Stegocephaloidea
Family Stegocephalidae

Andaniopsis nordlandica (Boeck, 1871). Boreal regions of North Atlantic; not previously reported in western Atlantic; 40–600 m, epibenthic (Sars 1895; Stephensen 1935).

Southern Georges Bank, 84 m, gravel bottom, 10.5 °C.

Stegocephalus inflatus Krøyer, 1842. Circumpolar Arctic; in western Atlantic: Arctic south to Rhode Island; 30–600 m, gravel to clay bottoms, epibenthic, predator? (Sars 1895; Stephensen 1935; Bousfield 1973).

Perimeter of Georges Bank, 121–196 m, sand and silt-clay bottoms, 6.6 °–7.6 °C.

Family Acanthonotozomatidae

Acanthonotozoma serratum (Fabricius, 1780). Circumpolar Arctic; in western Atlantic: Arctic south to Bay of Fundy; 10–300 m, gravel to silt-clay bottoms, epibenthic (Sars 1895; Stephensen 1938; Gurjanova 1951).

Northeast Peak of Georges Bank (southern range extension in western Atlantic); 79–198 m, sand and gravel bottoms, 7.8 °–8.2 °C.

Superfamily Synopioidea
Family Synopiidae

Syrrhoe crenulata Goes, 1866. Boreal regions of North Atlantic and North Pacific Oceans; in western Atlantic: Arctic south to Cape Cod; 40–200 m, epibenthic detritivore (Sars 1895; Barnard 1972).

Northeast Peak of Georges Bank, 77–101 m, sand bottom, 8.4 °C.

Tiron spiniferum (Stimpson, 1853). Circumboreal; in western Atlantic: Arctic south to New England coast; 30–200 m, epibenthic (Sars 1895; Barnard 1972).

Northeast Peak of Georges Bank, 93–198 m, gravel and gravelly sand, 7.7 °–8.4 °C.

Family Argissidae

Argissa hamatipes (Norman, 1869). Northern Hemisphere, subarctic to warm temperate; in western Atlantic: Labrador south to North Carolina, 4–1,720 m, gravel to silt-clay bottoms (Barnard 1971; Bousfield 1973).

Southeast Part of Georges Bank, 60–82 m, sand bottom.

Superfamily Pardaliscoidea
Family Pardaliscidae

Halice abyssi Boeck, 1871. Arctic-Boreal regions of North Atlantic; not previously recorded in western Atlantic; 200–800 m, mud bottoms (Sars 1895; Stephensen 1938).

Western Basin of Georges Bank, 168–183 m, silt-clay bottom, 6.6 °–7.2 °C.

Pardalisca cuspidata Krøyer, 1842. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to New England; 10–750 m, sand to silt-clay bottoms (Sars 1895; Gurjanova 1951; Bousfield 1973).

Northeast Peak of Georges Bank, 132 m.

Superfamily Ampeliscoidea
Family Ampeliscidae

Ampelisca agassizi (Judd, 1896). Atlantic and Pacific coasts of North America; in western Atlantic: Nova Scotia south to Caribbean; 5–450 m, coarse sand to silt-clay bottoms, detritivore, tubedweller (Mills 1971; Dickinson et al. 1980).

Southern Georges Bank, 60–170 m, sand bottoms, 6.6 °–12.6 °C, often occurs in high densities (100–10,000/m²).

Ampelisca declivitatis Mills, 1967. Northwestern Atlantic: western Greenland south to North Carolina; 100–1,000 m, sand to silt-clay bottoms, probably a tube-dwelling detritivore (Mills 1971; Dickinson et al. 1980).

Western Basin of Georges Bank, 150–170 m, sand and silty-sand bottoms.

Ampelisca macrocephala Liljeborg, 1852. Arctic-Boreal in North Atlantic, North Pacific, and Arctic Oceans; in western Atlantic: Greenland south to New Jersey; 5–1,700 m, stable sand bottoms, detritus feeding tubedweller (Barnard 1971; Mills 1971; Bousfield 1973).

Perimeter of Georges Bank, 66–168 m, sand bottoms, 7.3 °–12.2 °C.

Ampelisca vadorum Mills, 1963. Western Atlantic: Gulf of St. Lawrence to Gulf of Mexico; 0–100 m, medium to coarse sand, detritus feeding tubedweller (Mills 1967; Bousfield 1973; Dickinson et al. 1980).

North and central Georges Bank, 20–80 m, coarse and medium sand, 7.6 °–8.4 °C.

Byblis gaimardi (Krøyer, 1846). North Atlantic and Arctic Oceans; in western Atlantic: Greenland south to Cape Cod; 5–575 m, sand bottoms, detritus feeding tubedweller (Mills 1971).

Western Basin of Georges Bank, 154 m, sand bottom.

Byblis serrata (Smith, 1873). Western Atlantic: Cape Cod to Cape Hatteras; 0–200 m, medium to coarse sand, detritus feeding tubedweller (Mills 1971; Dickinson et al. 1980).

Southern Georges Bank, 44–123 m, sand bottom, 7.3 °–11.6 °C, moderately abundant (10–500/m²).

Haploops tubicola Liljeborg, 1856. Circumpolar Boreo-Arctic species; in western Atlantic: Arctic south to Gulf of Maine; 10–400 m, sand to silt-clay bottoms, detritus feeding tubedweller (Sars 1895; Stephensen 1935; Mills 1971).

Western Basin and perimeter of Georges Bank, 79–179 m, sand to silt-clay bottoms, 6.3 °–7.4 °C.

Superfamily Melphidippoidea
Family Melphidippidae

Melphidippa goesi Stebbing, 1899. Boreal regions of North Atlantic; in western Atlantic: Labrador south to Gulf of Maine; 30–300 m, filter feeder (Sars 1895; Stephensen 1938; Enequist 1949).

Western Basin and Northern Edge of Georges Bank, 157–183 m, sand and silt-clay bottoms, 6.6 °–7.6 °C.

Family Hornelia—Cheirocratus group

Casco bigelowi (Blake, 1929). Western Atlantic: Gulf of St. Lawrence south to Maryland; 0–400 m, sand to silt-clay bottoms, epibenthic, omnivore (Bousfield 1973; Dickinson et al. 1980).

Perimeter of Georges Bank, 68–179 m, sand and silt-clay bottoms, 5.3 °–12.8 °C.

Superfamily Melitoidea
Family Melitidae

Eriopisa elongata (Bruzelius, 1859). Arctic-Boreal regions of North Atlantic and North Pacific; in western Atlantic: Cape Cod south to New Jersey; 60–1,200 m, sand to silt-clay bottoms, burrowing deposit feeder (Sars 1895; Enequist 1949; Barnard 1971; Dickinson et al. 1980).

Southwest Georges Bank, 92 m, sand bottom.

Maera danae Stimpson, 1853. Western Atlantic: Gulf of St. Lawrence south to New Jersey; 0–50 m, gravel and silt-clay bottoms, epibenthic omnivore (Bousfield 1973).

Northern Edge of Georges Bank, 103 m, sand bottom.

Melita dentata Krøyer, 1842. Arctic-Boreal regions of North Atlantic and Arctic Oceans; in western Atlantic: Arctic south to Maryland; 0–300 m, gravel and sand bottoms, epibenthic omnivore (Bousfield 1973).

Perimeter of Georges Bank, 46–183 m, gravel and sand bottoms, 7.1°–11.6°C.

Melita sp. A. (undescribed species). Western Atlantic: Cape Cod south to New Jersey; 70–100 m, sand and silty sand bottoms (Dickinson et al. 1980).

Southern edge of Georges Bank, 92–114 m, sand bottom.

Melita sp. B. (undescribed species). Northeast Peak of Georges Bank, 86–194 m, gravel and gravelly sand.

Superfamily Corophioidea

Family Photidae

Gammaropsis maculatus (Johnston, 1827). Boreal regions of North Atlantic; in western Atlantic: Arctic south to North Carolina; 20–200 m, gravel and gravelly sand, detritus feeders (Sars 1895; Bousfield 1973; Fox and Bynum 1975).

Northeast Peak of Georges Bank; 79–93 m, gravel bottoms.

Photis dentata Shoemaker, 1945. Western Atlantic: Maine south to Florida; 49–92 m, sand bottom, probably a tube-dwelling detritivore (Shoemaker 1945a; Dickinson et al. 1980).

Western portion of Georges Bank, 35–124 m, sand and gravelly sand bottoms.

Photis macrocoxa Shoemaker, 1945. Western Atlantic: Gulf of St. Lawrence south to Virginia; 0–100 m, sand and silt bottoms, probably a tube-dwelling detritivore (Bousfield 1973).

Central and southern Georges Bank; 33–93 m, sand bottom.

Podoceropsis nitida (Stimpson, 1853). Boreal regions of North Atlantic; in western Atlantic: Gulf of St. Lawrence south to New Jersey; 0–50 m, primarily on rocky bottoms, probably a detritivore (Bousfield 1973; Watling 1979).

Perimeter of Georges Bank, 35–179 m, gravel and sand bottoms, 4.9°–12.3°C.

Protomedeia fasciata Krøyer, 1842. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to New Jersey; 15–115 m, sand and gravelly sand, burrowing detritivore (Sars 1895; Enequist 1949).

Perimeter of Georges Bank, 62–146 m, gravel to sand bottoms.

Family Ischyroceridae

Ericthonius rubricornis Smith, 1873. Boreal regions of North Atlantic; in western Atlantic: Labrador south to Cape Hatteras; 0–400 m, gravel to silt-clay bottoms, filter-feeding tubedweller (Enequist 1949; Bousfield 1973; Dickinson et al. 1980).

Perimeter of Georges Bank, 46–192 m, gravelly sand and sand bottoms, moderately abundant along southern edge of Georges Bank reaching densities of 500/m².

Ischyrocerus anguipes Krøyer, 1838. Subarctic and Boreal regions of North Atlantic; in western Atlantic: Hudson Strait south to Cape Hatteras; 0–60 m, primarily on hard substratum, tubedweller (Bousfield 1973).

Perimeter of Georges Bank, 35–94 m, sand and gravel bottoms.

Ischyrocerus megacheir (Boeck, 1871). Arctic-Boreal regions of the North Atlantic; in western Atlantic: Arctic south to Gulf of St. Lawrence; 80–1,400 m, gravel and silt-clay bottoms, tube-dwelling detritivore (Sars 1895; Stephensen 1942; Enequist 1949).

Northeast Peak and Western Basin of Georges Bank (southernmost records), 112–196 m, gravel and gravelly sand bottoms.

Family Amphithoidae

Amphithoe rubricata (Montagu, 1808). Amphi-Atlantic; in western Atlantic: Arctic south to Long Island Sound; 0–40 m, algae bottoms, tubedweller, herbivore (Stephensen 1942; Enequist 1949; Bousfield 1973).

Southeastern Georges Bank (unusual record, normally confined to nearshore area), 62 m.

Family Aoridae

Leptocheirus pinguis (Stimpson, 1853). Western Atlantic: Labrador south to North Carolina; 0–250 m, sand to silt-clay bottoms, tubedweller, filter-feeding detritivore (Bousfield 1973; Dickinson et al. 1980).

Perimeter of Georges Bank, 44–179 m, sand and gravelly sand bottoms, 7.1°–12.2°C, moderately abundant on Georges Bank often reaching densities of 400/m².

Pseudunciola obliquua (Shoemaker, 1949). Western Atlantic: Bay of Fundy south to Virginia; 0–100 m, sand-gravel to silty sand, tubedweller, detritivore (Bousfield 1973; Dickinson et al. 1980).

Southern Georges Bank, 64–103 m, sand and shelly sand.

Unciola dissimilis Shoemaker, 1945. Western Atlantic: Massachusetts to North Carolina; 0–1,000 m, sand and silty sand bottoms, tube-dwelling detritivore (Shoemaker 1945b; Bousfield 1973).

Western Georges Bank, 20–135 m, sand bottoms, 4.4°–11.6°C.

Unciola inermis Shoemaker, 1945. Western Atlantic: Bay of Fundy south to North Carolina, 0–200 m, sand and silty-sand bottoms, tube-dwelling detritivore (Shoemaker 1945b; Dickinson et al. 1980).

Perimeter of Georges Bank, 57–192 m, sand and gravelly sand bottoms, 7.1°–11.2°C, high densities between 10 and 2,000/m².

Unciola irrorata Say, 1818. Western Atlantic: Gulf of St. Lawrence south to South Carolina; 6–500 m, sand-gravel to silt-clay bottoms, tube-dwelling detritivore (Shoemaker 1945b; Bousfield 1973; Dickinson et al. 1980).

Central Georges Bank, 35–168 m, gravel and sand bottoms, 7.1°–12.6°C, moderate densities 10–500/m².

Unciola spicata Shoemaker, 1945. Western Atlantic: Long Island south to Florida; 40–800 m, sand and silty sand bottoms (Shoemaker 1945b; Dickinson et al. 1980).

Southern edge of Georges Bank, 114–124 m, sand bottoms.

Family Corophiidae

Corophium crassicorne Bruzelius, 1859. Arctic-Boreal regions of North Atlantic and North Pacific; in western Atlantic: Arctic south to Virginia, 0–200 m, gravel to silty sand, tubedweller, filter-feeding detritivore (Bousfield 1973; Dickinson et al. 1980).

Perimeter of Georges Bank, 35–146 m, gravel and sand bottoms, 8.3 °–12.3 °C.

Siphonoecetes smithianus Rathbun, 1908. Western Atlantic: Cape Cod south to Maryland, 10–90 m, sand bottoms, tube-dwelling detritivore (Bousfield 1973; Dickinson et al. 1980).

Southwest Georges Bank, 66 m, sand bottom.

Family Podoceridae

Dyopedos arcticus (Murdoch, 1884). Boreo-Arctic regions of North Atlantic and North Pacific; in western Atlantic: Arctic south to Cape Cod; 10–75 m, filter feeder (Laubitz 1977).

Northeast Peak of Georges Bank, 99 m, sand bottom, 8.9 °C.

Dyopedos monacantha (Metzger, 1875). Boreal regions of North Atlantic; in western Atlantic: Arctic south to Virginia; 20–300 m, gravel to silt-clay bottoms, filter feeder (Laubitz 1977; Dickinson et al. 1980).

Perimeter of Georges Bank, 35–187 m, sand and gravel bottoms, 6.8 °–11.3 °C.

Dulichia tuberculata Boeck, 1870. Boreo-Arctic regions of North Atlantic; in western Atlantic: Arctic south to Cape Cod; 10–600 m, rock and gravel bottoms, filter feeder (Stephensen 1935; Laubitz 1977).

Northern Edge of Georges Bank, 156 m, sand bottom.

Paradulichia typica Boeck, 1870. Arctic-Boreal regions of North Atlantic; in western Atlantic: Arctic south to Cape Cod; 60–1,100 m, silt-clay bottoms, filter feeder (Gurjanova 1951; Laubitz 1977).

Western Basin of Georges Bank, 157–187 m, sand and silt-clay bottoms, 6.6 °–6.8 °C.

DISCUSSION

Zoogeography

Georges Bank lies in the latitudes where the Boreal (cold-temperate) and Virginian (warm-temperate) faunal provinces overlap (Bousfield 1973; Briggs 1974). In his study of the inshore gammaridean fauna of the Cape Cod region, Bousfield (1973) found the Virginian forms composed two-thirds of his species list. In contrast, we found that two-thirds of the species on Georges Bank were Boreal forms having their centers of distribution in the cold waters north of Cape Cod. However, it should be noted that the shallow central portions of the bank are chiefly inhabited by Virginian species, and that nearly all the Boreal forms are restricted to the perimeter of the bank. Therefore, our results are in agreement with Bousfield's findings.

Briggs (1974), in his discussion of the zoogeography of the northwest Atlantic, summarized data for both fish and invertebrates which showed a clear trend for cold-temperate forms to be amphi-Atlantic while most warm-temperate species are endemic to the western Atlantic. The data presented in Bousfield (1973), Dickinson et al. (1980), and this report indicate that this distributional pattern is also true for gammarideans.

Species Distribution Patterns

None of the 97 species collected were ubiquitous over the entire Georges Bank region, all of them were restricted in their distribution to some degree. In comparing the spatial patterns of gammarideans on the bank, it became apparent that many species had similar patterns. One of six patterns could be used to characterize nearly all the species (Fig. 16). Although these patterns are idealized and not followed exactly by each species, they were useful in simplifying the data and in providing insights into which environmental factors may be important in controlling gammaridean distributions on Georges Bank. A discussion of each of these patterns and the species described by it follows.

Northeast Peak

A group of six species (Table 1) showed a strong association with gravel sediments and cold year-round temperatures (6 °–8 °C) of the Northeast Peak. This group of species showed a high fidelity to the Northeast Peak with only *Anonyx sarsi*

Table 1.—Six patterns of gammaridean distribution on Georges Bank. Species in parentheses occurred in only one or two collections.

Northeast Peak	*Monoculopsis longicornis*
Acanthonotozoma serratum	*Paradulichia typica*
Anonyx sarsi	*Rhachotropis distincta*
(*Dyopedos arcticus*)	*Stegocephalus inflatus*
Gammaropsis maculatus	*Tmetonyx cicada*
Melita sp. B	
Neopleustes pulchellus	Shoals
(*Pardalisca cuspidata*)	*Ampelisca vadorum*
Tiron spiniferum	*Amphiporea gigantea*
(*Tryphosella nanoides*)	*Pontogeneia inermis*
(*Westwoodilla magalops*)	*Psammonyx nobilis*
Perimeter	Southern Edge
Ampelisca macrocephala	*Ampelisca agassizi*
Anonyx liljeborgi	*Argissa hamatipes*
Casco bigelowi	(*Eriopisa elongata*)
Corophium crassicorne	(*Gammarus annulatus*)
Dyopedos monacantha	*Melita* sp. A
Ericthonius rubricornis	*Orchomene minuta*
Harpinia propinqua	*Pleustes panoplus*
Hippomedon propinquus	*Rhachotropis inflata*
Leptocheirus pinguis	*Rhachotropis oculata*
Melita dentata	*Stenopleustes inermis*
Orchomene pinguis	(*Synchelidium americanum*)
Photis dentata	
Phoxocephalus holbolli	Central
Pleusymtes glaber	*Acanthohaustorius intermedius*
Podoceropsis nitida	*Acanthohaustorius similis*
Protomedeia fasciata	*Acanthohaustorius spinosus*
Stenopleustes gracilis	*Acanthohaustorius* sp. C.
	Acanthohaustorius sp. D.
Western Basin	*Bathyporeia quoddyensis*
Ampelisca declivitatis	*Byblis serrata*
(*Anonyx debruyni*)	*Hippomedon serratus*
Bathymedon sausserei	*Monoculodes edwardsi*
(*Byblis gaimardi*)	*Parahaustorius holmesi*
(*Dulichia tuberculata*)	*Parahaustorius longimerus*
Epimeria loricata	*Paraphoxus epistomus*
(*Eusirus cuspidatus*)	*Photis macrocoxa*
Halice abyssi	*Protohaustorius deichmannae*
Halirages fulvocinctus	*Protohaustorius wigleyi*
Haliragoides inermis	*Pseudohaustorius borealis*
Haploops tubicola	*Pseudunciola obliquua*
Ischyrocerus megacheir	*Stenothoe minuta*
Melphidippa goesi	*Unciola irrorata*

occurring outside this area. These species are all Arctic-Boreal and probably limited to the perimeter by their temperature tolerance, but their preference for gravelly sediments probably accounts for their further restriction to the Northeast Peak. A group of four species represented by single occurrences on the Northeast Peak are also listed in Table 1 as other species which might show this distribution pattern if more data were available.

Perimeter

A group of 17 species (Table 1) was distributed around the perimeter of the bank. The bottom temperatures around the perimeter generally have an annual range between 4° and 13 °C, being warmer in the Great South Channel and cooler along the Northern Edge. The sediments of the perimeter are fine sands except for gravel on the Northeast Peak and medium to coarse sand in the Great South Channel. It is noteworthy that all 17, although having boreal distributions, are reported south of Georges Bank (Dickinson et al. 1980) in contrast to the species restricted to the Northern Edge and Western Basin. It seems likely that this group of species is excluded from the central parts of Georges Bank by the warmer summer temperatures (14°–18 °C) and greater annual temperature range (3°–18 °C) found there. It is clear that sediment type may also play a role in restricting the distribution of some of these species since they are absent from the Northeast Peak or Great South Channel portions of the perimeter.

Western Basin

A group of 14 species (Table 1) was restricted to the Western Basin and Northern Edge. This area is characterized by the coldest year-round temperatures (4°–6 °C) and the finest sediments on the bank. Three species in the group (*Haploops tubicola, Stegocephalus inflatus,* and *Tmetonyx cicada*) had single records on the Southern Edge of the bank, but their distributions seemed to be better described by a "Western Basin" pattern than a "Perimeter" pattern. Only 2 of the 14 species occurred south of Georges Bank, and they (*Ampelisca declivitatis* and *Tmetonyx cicada*) were reported only from bathyal depths (Dickinson et al. 1980). Since these records constitute the southern limit for most of these species, we suspect that temperature limits their distribution on the bank to this area of cold year-round bottom temperatures. An additional group of four species are also listed in Table 1 as other species which might show this pattern if more data were available.

Shoals

Only a small group of species (Table 1) occurs in the gravelly sands of the northern shoals. This area of the bank is characterized by strong currents that continually rework the sediments. The shoals also experience the greatest annual temperature range (4°–16 °C). Three of the four species found in the shoals are known to be associated with coarse sands, and they are usually found in shallow turbulent sand communities of the open coast. *Pontogeneia inermis* is a pelagic-epibenthic species which is ubiquitous over the central parts of Georges Bank. It is probable that other gammarideans may be associated with the shoals, but we may have missed them in our limited collections from this part of the bank.

Southern Edge

A group of eight species (Table 1) was restricted in their distribution to the Southern Edge of the bank. This area is characterized by fine sands and a narrow annual temperature range fluctuating between 8° and 11 °C. Since these species are all cold-water forms, it seems likely that distribution around the perimeter of Georges Bank is limited by their preference for fine sands. Three additional species are listed in Table 1 since we suspect they might show this pattern if more data were available.

Central

A group of 19 species (Table 1) is associated with the medium sand sediments and warmer summer temperatures (12°–14 °C) of the central portions of the bank. However, this group of species seems to avoid the northern shoals area of the bank. These species all have Virginian distributions and are endemic to the western Atlantic. Some species in this group such as members of the family Haustoriidae have limited distributions on the bank, probably reflecting their need for special sediment characteristics. Other species in this group such as *Unciola irrorata* and *Monoculodes edwardsi* are broadly distributed in the central region of the bank. In general, we suspect that this species group is restricted from the perimeter of the bank by the cold year-round temperatures and from the shoals by the turbulence.

ACKNOWLEDGMENTS

We thank our associates at the Northeast Fisheries Center in Woods Hole, particularly Bruce Burns, Gilbert Chase, Evan Haynes, Tom Morris, Betty Murray, Ruth Stoddard, and Henry Jensen for assistance in collecting and processing samples; Roger Theroux and Jacqueline Murray for their help in data processing; John Lamont for his assistance in drafting the figures; and Richard Langton for his critical reading of the manuscript. We would also like to thank E. L. Bousfield and Diane Laubitz of the National Museum of Canada, Ottawa, for their taxonomic assistance.

LITERATURE CITED

BARNARD, J. L.
1960. The amphipod family Phoxocephalidae in the Eastern Pacific Ocean, with analyses of other species and notes for a revision of the family. Allan Hancock Pac. Exp. 18:175-375.
1969. The families and genera of marine Gammaridean Amphipoda. U.S. Natl. Mus. Bull. 271, 353 p.
1971. Gammaridean Amphipoda from a deep-sea transect off Oregon. Smithson. Contrib. Zool. 61, 86 p.
1972. A review of the family Synopiidae (= Tironidae), mainly distributed in the deep sea (Crustacea:Amphipoda). Smithson. Contrib. Zool. 124, 94 p.
1979. Revision of American species of the marine amphipod genus Paraphoxus (Gammaridea: Phoxocephalidae). Proc. Biol. Soc. Wash. 92:368-379.

BOUSFIELD, E. L.
1965. The Haustoriidae of New England (Crustacea: Amphipoda). Proc. U.S. Natl. Mus. 117 (3512):159-239.
1970. Adaptive radiation in sand-burrowing amphipod crustaceans. Chesapeake Sci. 11:143-154.
1973. Shallow-water gammaridean Amphipoda of New England. Cornell Univ. Press, Ithaca, N.Y., 312 p.
1977. A new look at the Systematics of Gammaroidean Amphipods of the World. Crustaceana Suppl. 4:282-316.
1978. A revised classification and phylogeny of Amphipod Crustaceans. Trans. R. Soc. Can., Ser. IV, XVI:343-390.

BRIGGS, J. C.
1974. Marine zoogeography. McGraw Hill Co., N.Y., 475 p.
COLTON, J. B., Jr., and R. R. STODDARD.
1973. Bottom-water temperatures on the Continental Shelf, Nova Scotia to New Jersey. U.S. Dep. Commer., NOAA Tech. Rep. NMFS Circ. 376, 55 p.
CROKER, R. A.
1967. Niche diversity in five sympatric species of intertidal amphipods (Crustacea: Haustoriidae). Ecol. Monogr. 37:173-200.
DICKINSON, J. J., R. L. WIGLEY, R. D. BRODEUR, and S. BROWN-LEGER.
1980. Distribution of gammaridean Amphipoda (Crustacea) in the Middle Atlantic Bight region. U.S. Dep. Commer., NOAA Tech. Rep. NMFS SSRF-741, 46 p.
ENEQUIST, P.
1949. Studies on the soft-bottom amphipods of the Skagerak. Zool. Bidr. Upps. 28:297-492.
FOX, R. S., and K. H. BYNUM.
1975. The amphipod crustaceans of North Carolina estuarine waters. Chesapeake Sci. 16:223-237.
FRAME, A.
1980. Two new species of sand burrowing Amphipod crustaeceans from Long Island Sound and the New York Bight (Amphipoda: Haustoriidae). Estuaries 3:75–83.
GLENNON, T. A.
1979. Description of the male of *Amphiporeia gigantea* Bousfield (Amphipoda, Haustoriidae). Crustaceana 37:304-310.
GOSNER, K. L.
1971. Guide to identification of marine and estuarine invertebrates, Cape Hatteras to the Bay of Fundy. Wiley-Interscience, N.Y., 693 p.
GURJANOVA, E. F.
1951. Amphipoda-Gammaridea of the seas of the USSR and adjoining waters. Keys to the Fauna of the USSR. [In Russ.] Zool. Inst. Acad. Sci. USSR 41, 1029 p.
GUSEY, W. F.
1977. The fish and wildlife resources of the Georges Bank Region. Shell Oil Co., Houston, Tex., 553 p.
HAGER, R. P., and R. A. CROKER.
1979. Macroinfauna of Northern New England sand. IV. Infaunal ecology of *Amphiporeia virginiana* Shoemaker, 1933 (Crustacea:Amphipoda). Can. J. Zool. 57:1511-1519.
HOLMES, S. J.
1905. The Amphipoda of Southern New England. Bull. [U.S.] Bur. Fish. 24:459-529.
LAUBITZ, D. R.
1977. A revision of the genera *Dulchia* Krøyer and *Paradulichia* Boeck (Amphipoda, Podoceridae). Can. J. Zool. 55:942-982.
MILLS, E. L.
1967. A re examination of some species of Ampelisca (Crustacea: Amphipoda) from the east coast of North America. Can. J. Zool. 45: 635-652.
1971. Deep-sea Amphipoda from the western North Atlantic Ocean. The Family Ampeliscidae. Limnol. Oceanogr. 16:357-386.
SARS, G. O.
1895. An account of the Crustacea of Norway (with short descriptions and figures of all the species.) Vol. 1, Amphipoda. Alb Cammermeyers, Copenhagen, 711 p.
SCOTT, K. J., and R. A. CROKER.
1976. Macroinfauna of northern New England marine sand. III. The ecology of *Psammonyx nobilis* (Stimpson), 1853 (Crustacea: Amphipoda). Can. J. Zool. 54:1519-1529.
SHOEMAKER, C. R.
1930a. The lysianassid amphipod crustaceans of Newfoundland, Nova Scotia, and New Brunswick in the United States National Museum. Proc. U.S. Natl. Mus. 77(2827), 19 p.
1930b. The Amphipoda of the Cheticamp Expedition of 1917. Contrib. Can. Biol. 5:221-359.
1945a. The amphipod genus Photis on the east coast of North America. Charleston Mus. Leafl. 22:1-17.
1945b. The amphipod genus Unciola on the east coast of America. Am. Midl. Nat. 34:446-465.
SMITH, S., and O. HARGER.
1874. Report on the dredgings in the region of St. George's Banks, in 1872. Trans. Conn. Acad. Arts Sci. 3:1-57.
STEELE, D. H., and P. BRUNEL.
1968. Amphipoda of the Atlantic and Arctic coasts of North America: *Anonyx* (Lysianassidae). J. Fish. Res. Board Can. 25:943-1060.
STEELE, D. H., and V. J. STEELE.
1973. Some aspects of the biology of *Calliopius laeviusculus* (Krøyer) (Crustacea, Amphipoda) in the northwestern Atlantic. Can. J. Zool. 51:723-728.
STEPHENSEN, K.
1935. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. Tromsø Mus. Skr. III(I):1-140.
1938. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. Tromsø Mus. Skr. III(II):141-278.
1940. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. Tromsø Mus. Skr. III(III):279-362.
1942. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. Tromsø Mus. Skr. III(IV):363-526.
STEWART, H. B., JR., and G. F. JORDAN.
1964. Underwater sand ridges on Georges Shoal. *In* R. L. Miller (editor), Papers in marine geology, p. 102-114. Shepard Commemorative Volume. Macmillan, N.Y.
WATLING, L.
1979. Zoogeographic affinities of Northeastern North American Gammaridean Amphipoda. Bull. Biol. Soc. Wash. 3:256-282.
WHITELY, G. C., JR.
1948. The distribution of larger planktonic crustacea on Georges Bank. Ecol. Monogr. 18:233-264.
WIGLEY, R. L.
1961. Bottom sediments of Georges Bank. J. Sediment. Petrol. 31:165-188.

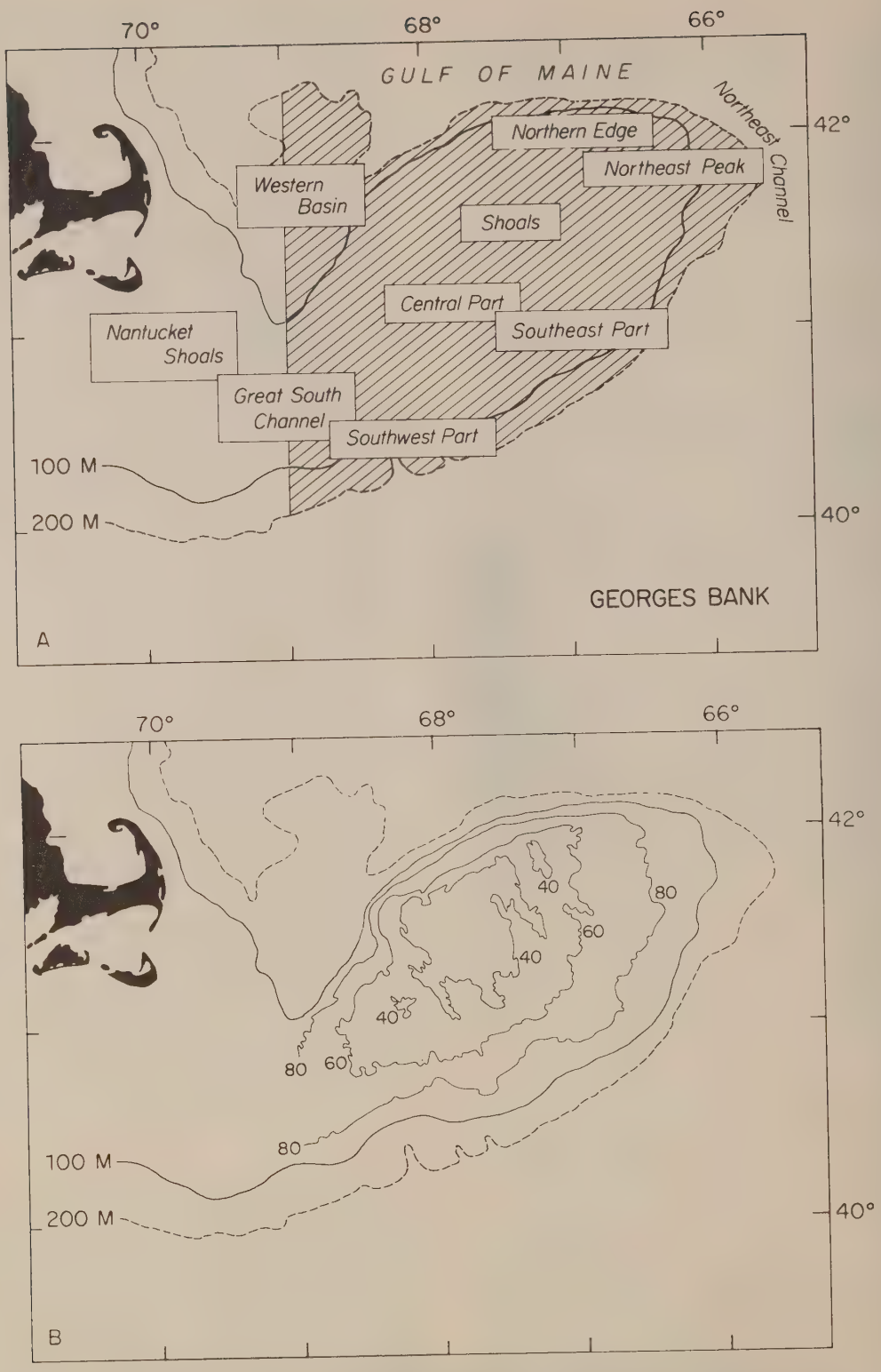

Figure 1.—A. Geographical features of Georges Bank region. The study area is defined by hatching. B. Bathymetry of Georges Bank in meters.

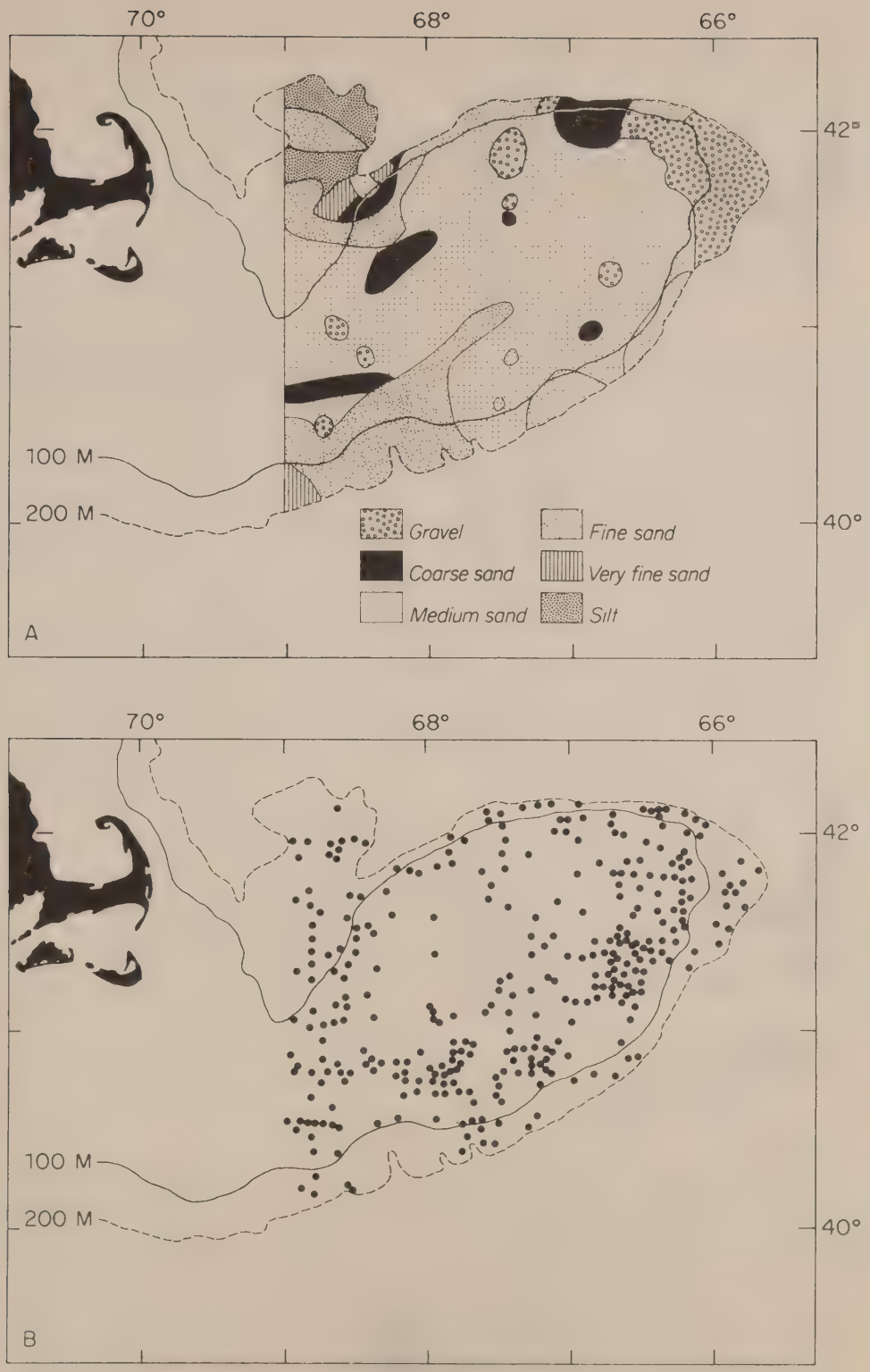

Figure 2.—A. Geographic distribution of bottom sediment types on Georges Bank (after Wigley 1961). B. Station locations on Georges Bank where samples were collected.

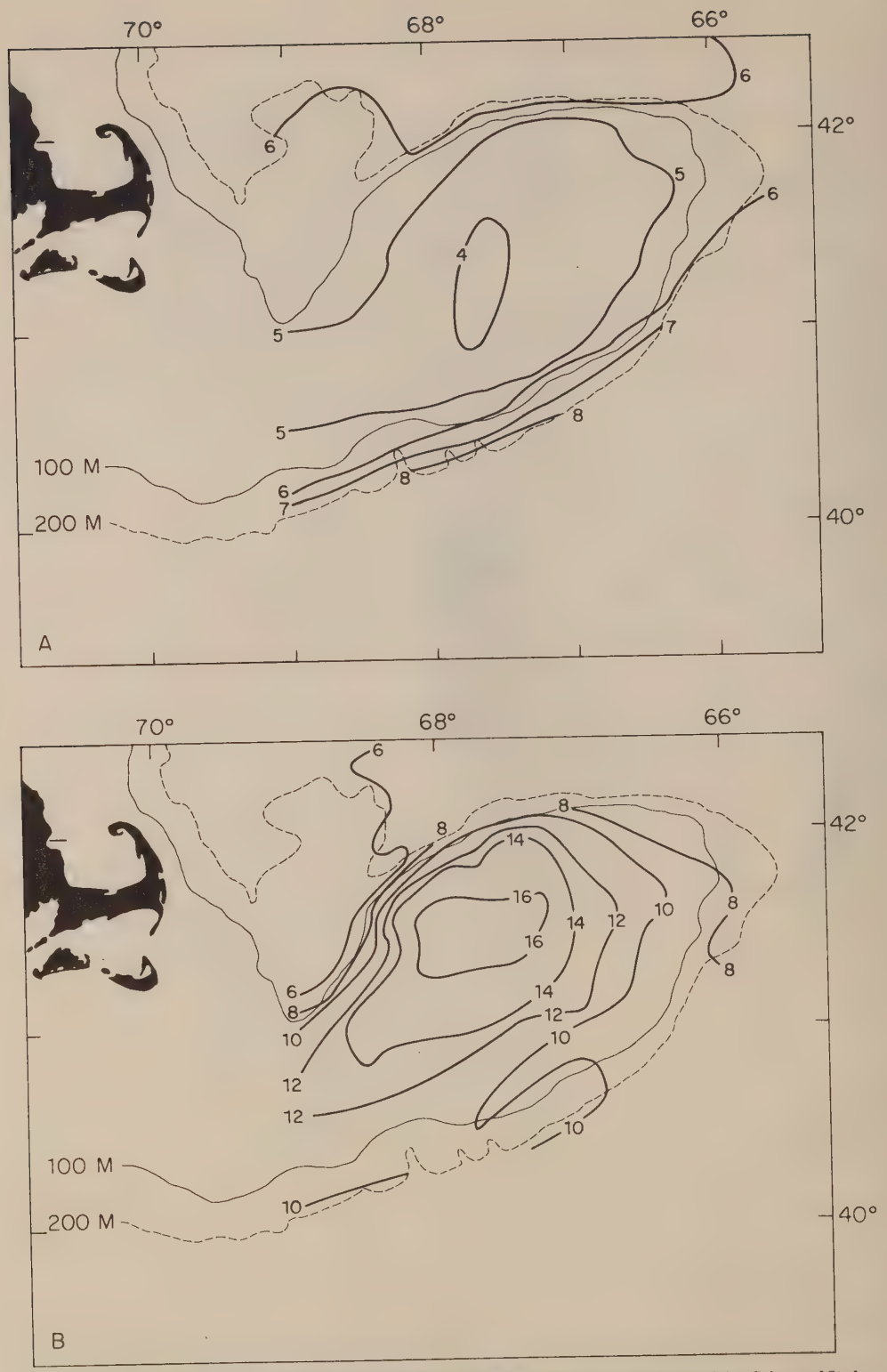

Figure 3.—A. Distribution of average bottom-water temperatures (°C) during February on Georges Bank (after Colton and Stoddard 1973). B. Distribution of average bottom-water temperatures (°C) during September on Georges Bank (after Colton and Stoddard 1973).

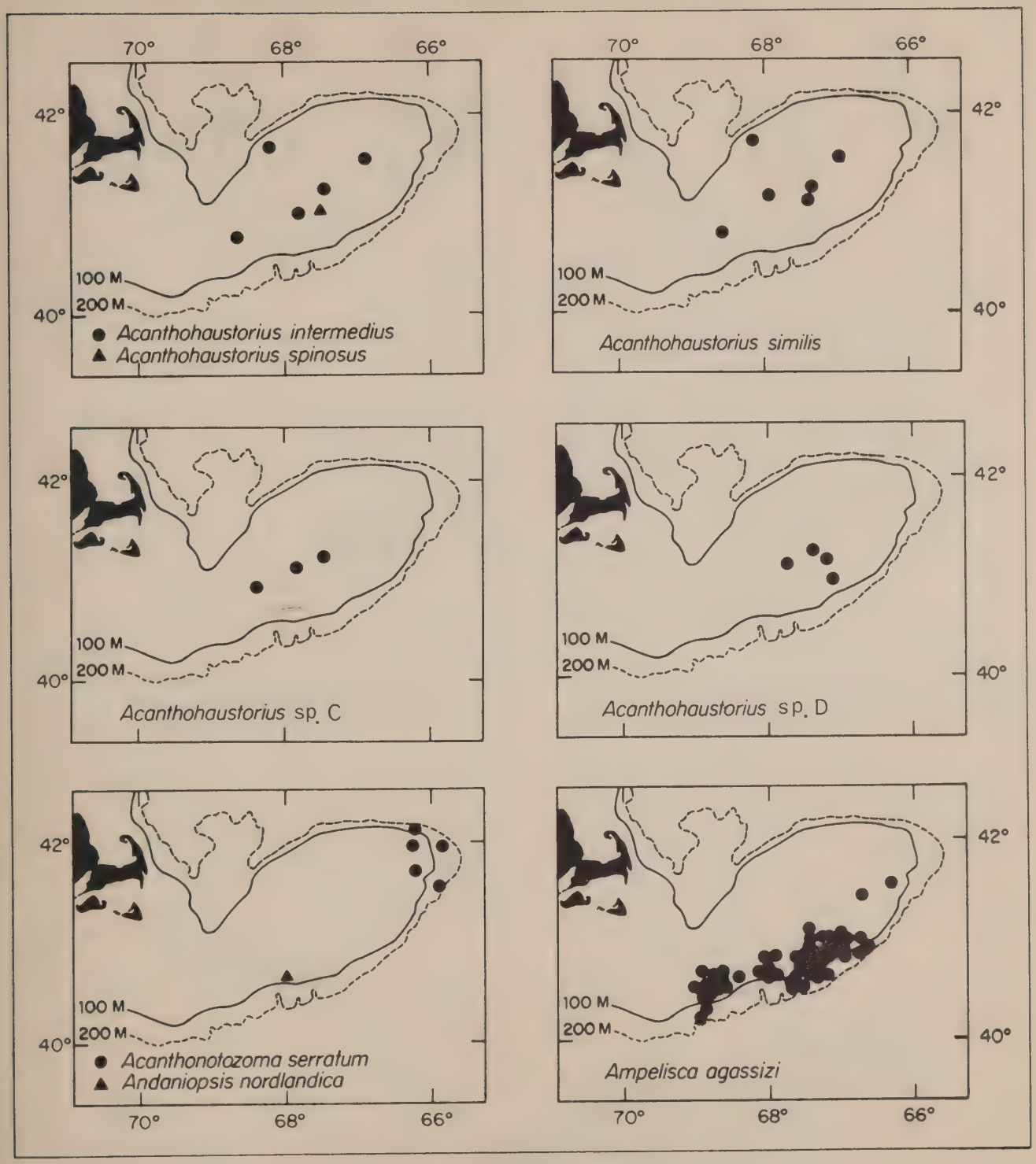

Figure 4.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.

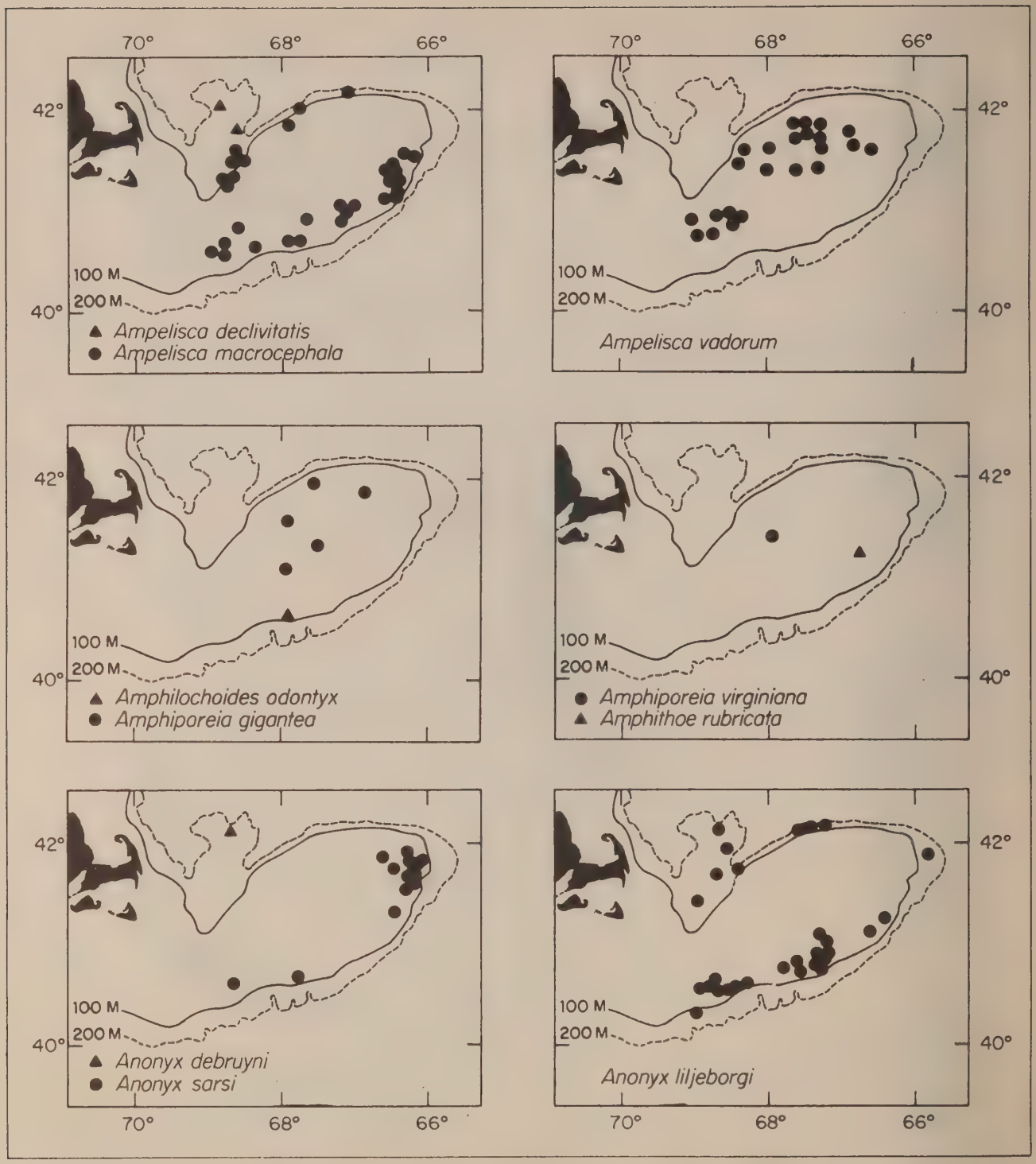

Figure 5.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

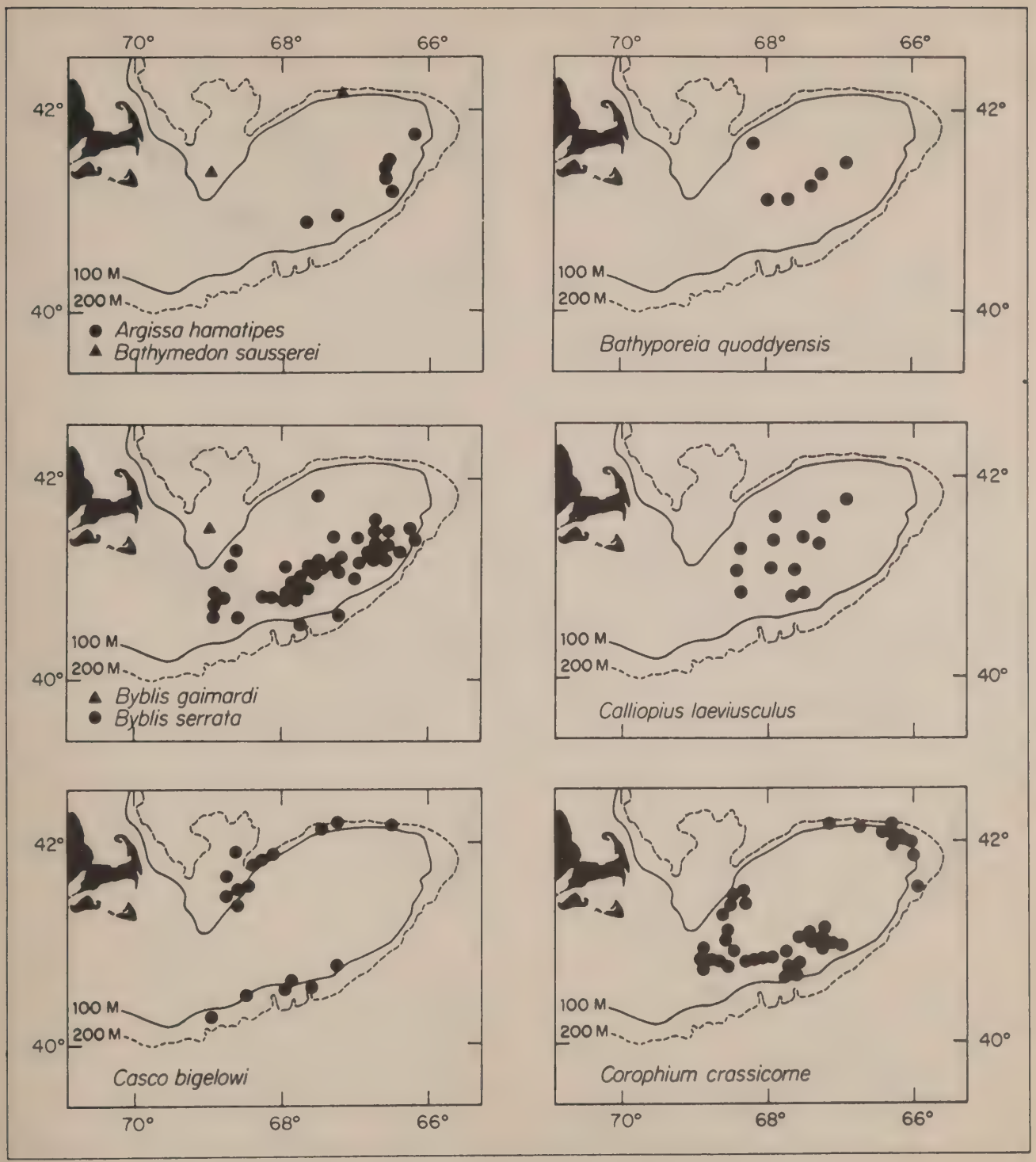

Figure 6.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

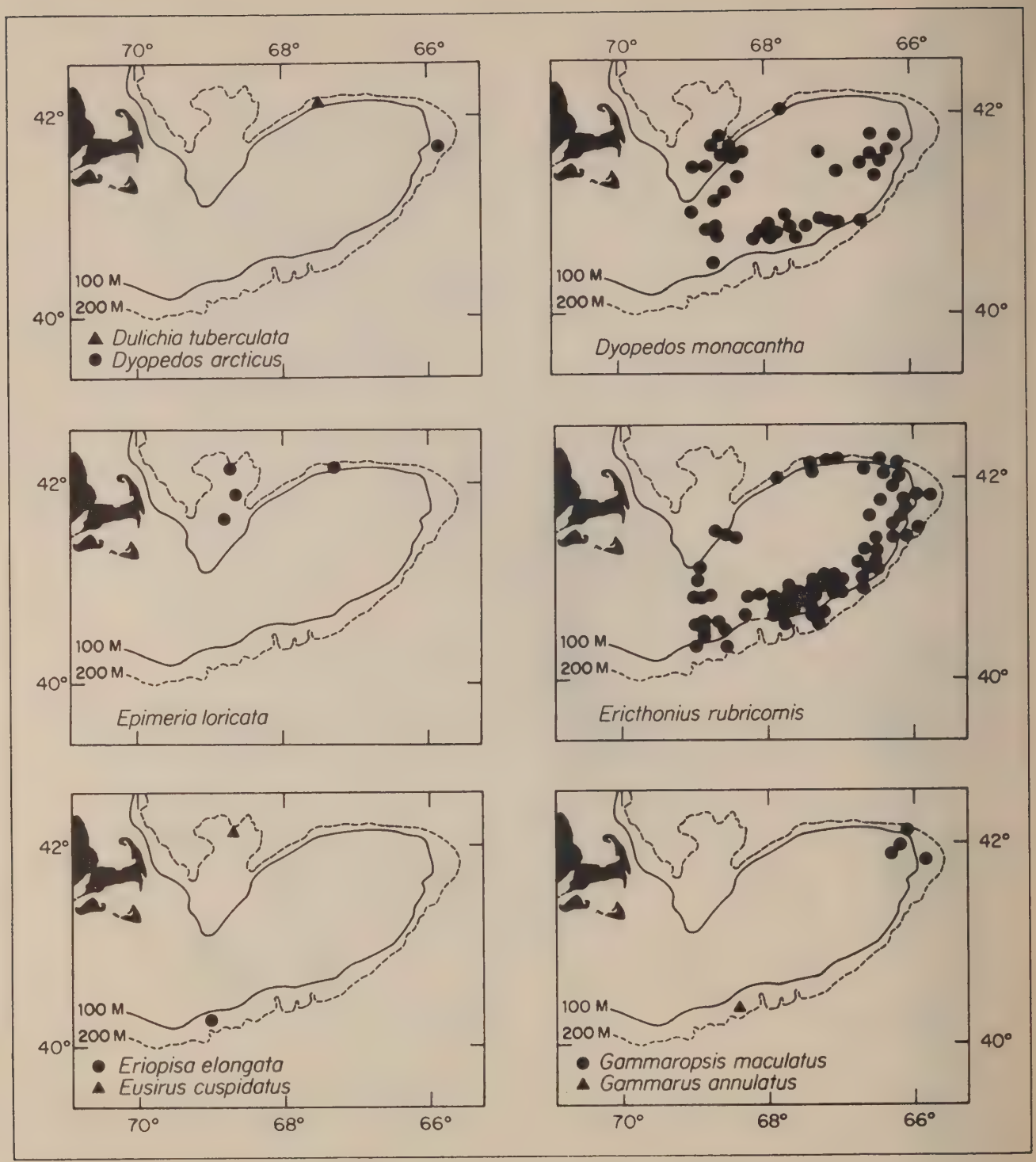

Figure 7.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

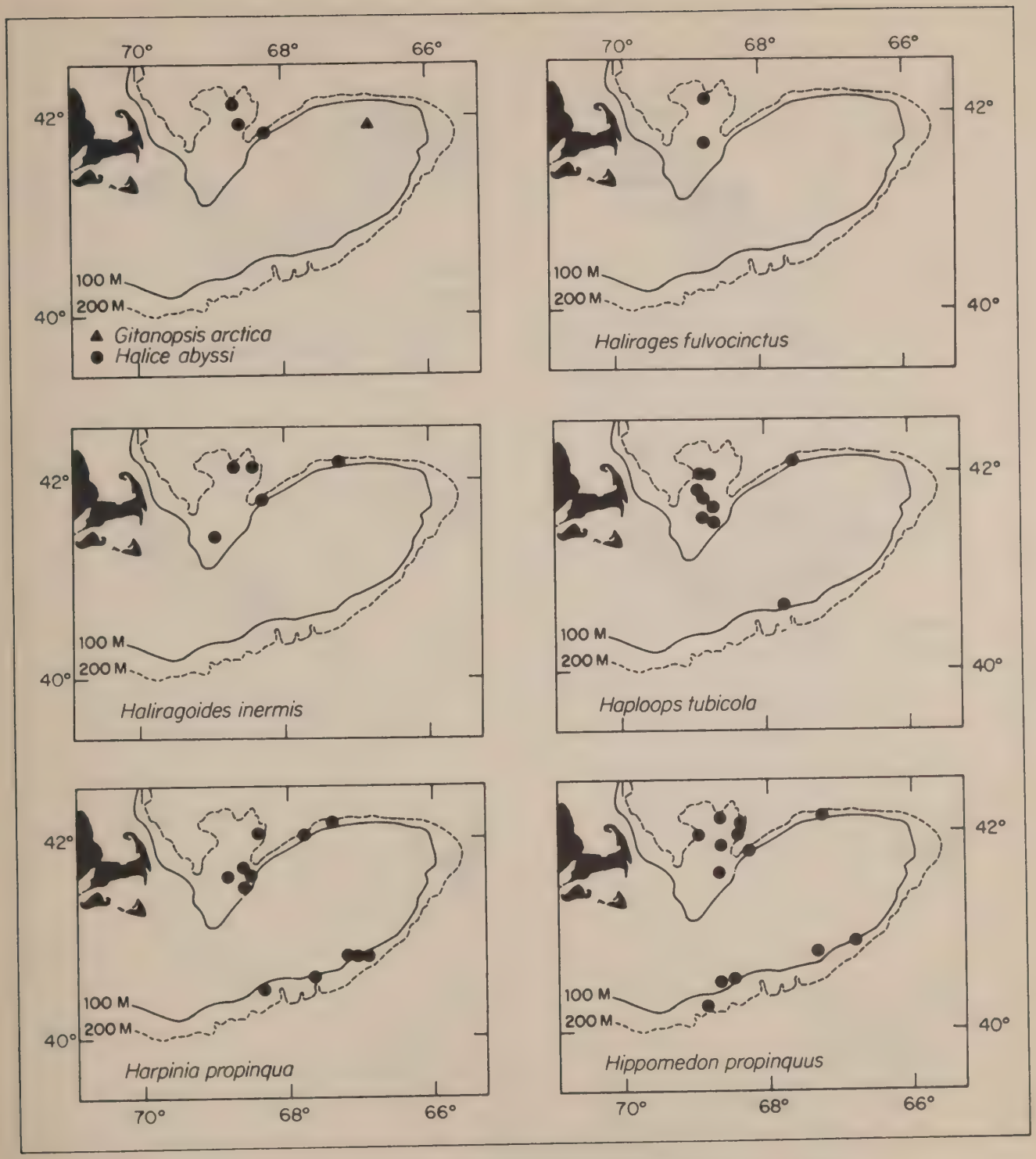

Figure 8.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

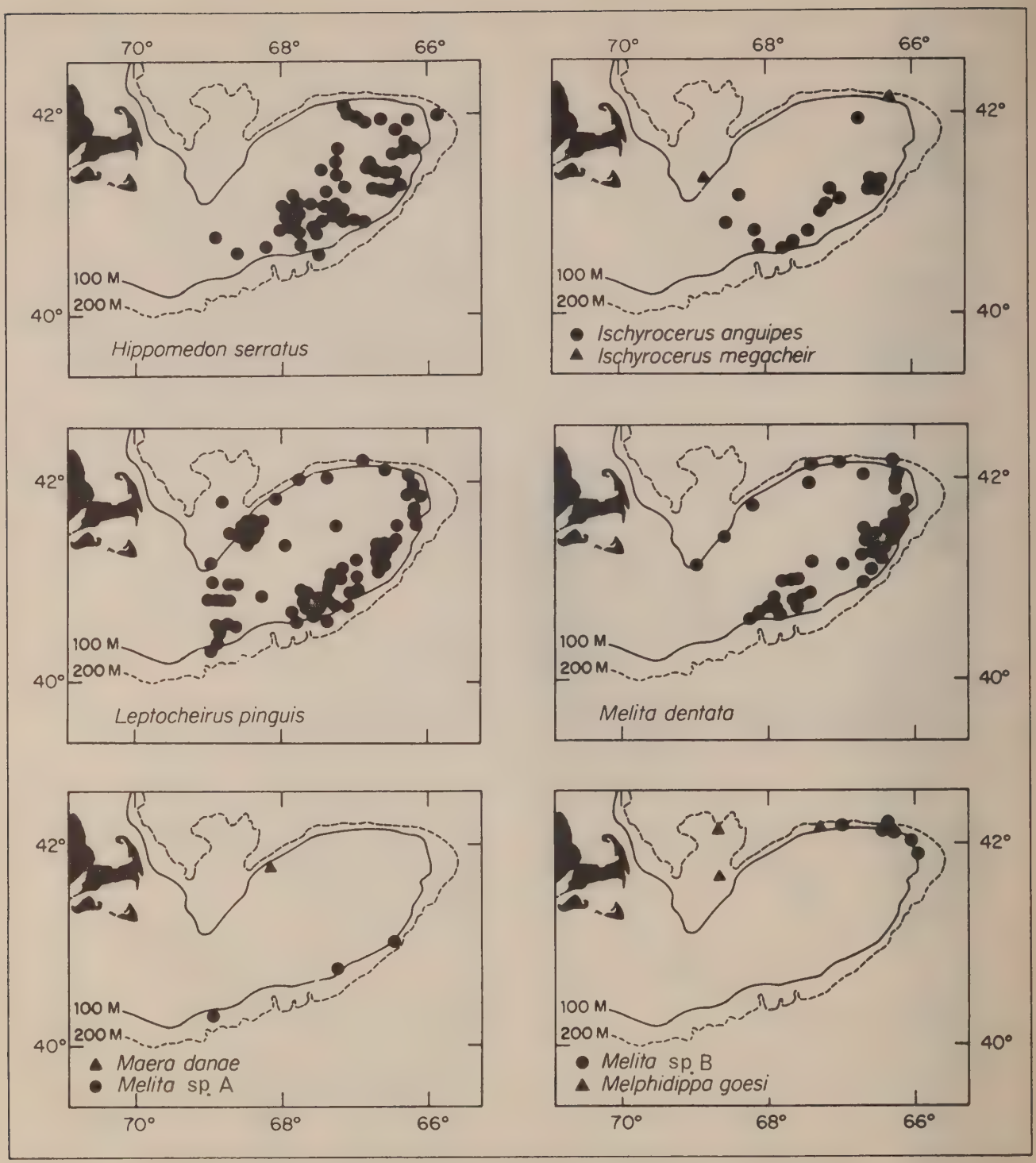

Figure 9.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

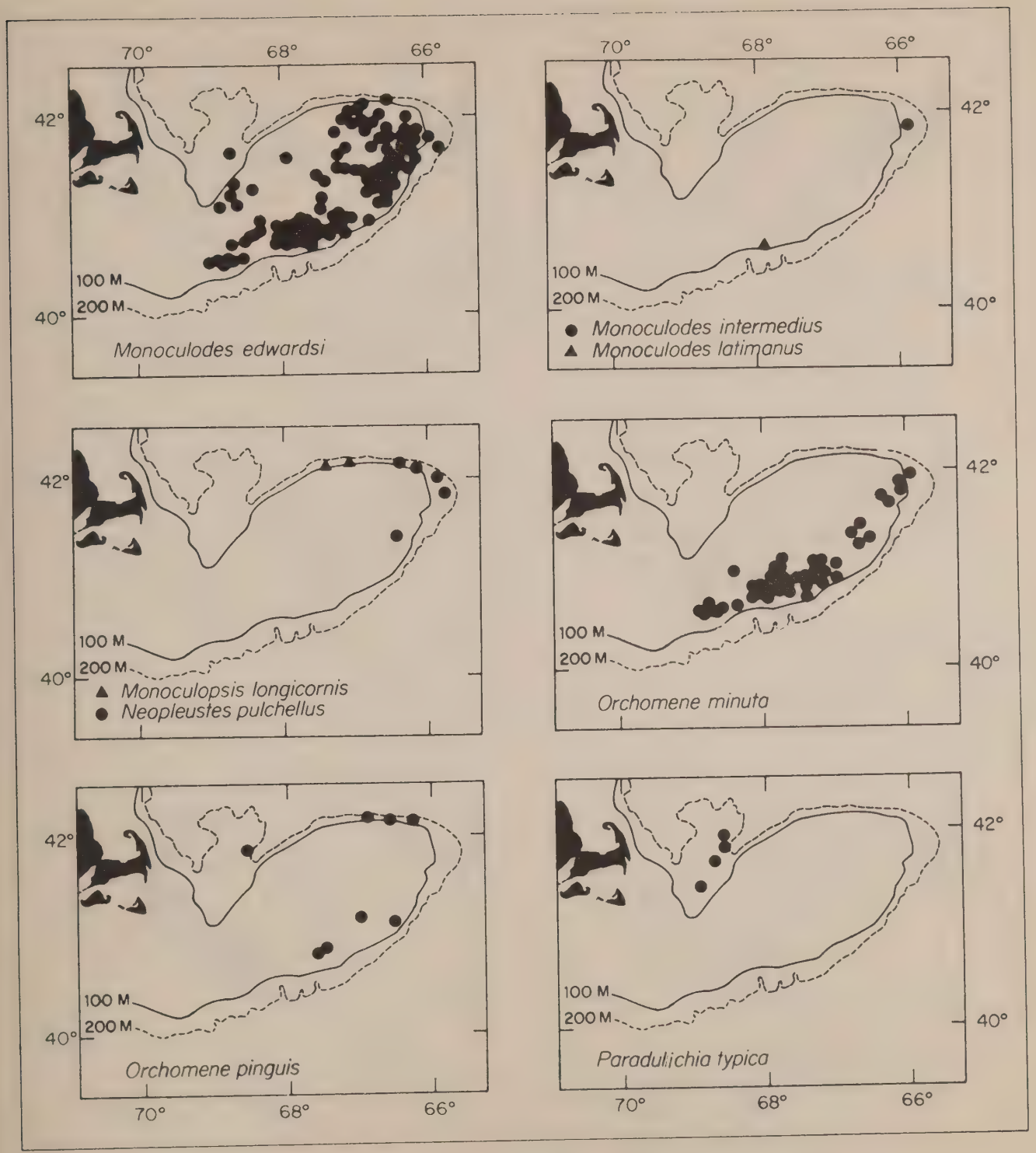

Figure 10.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

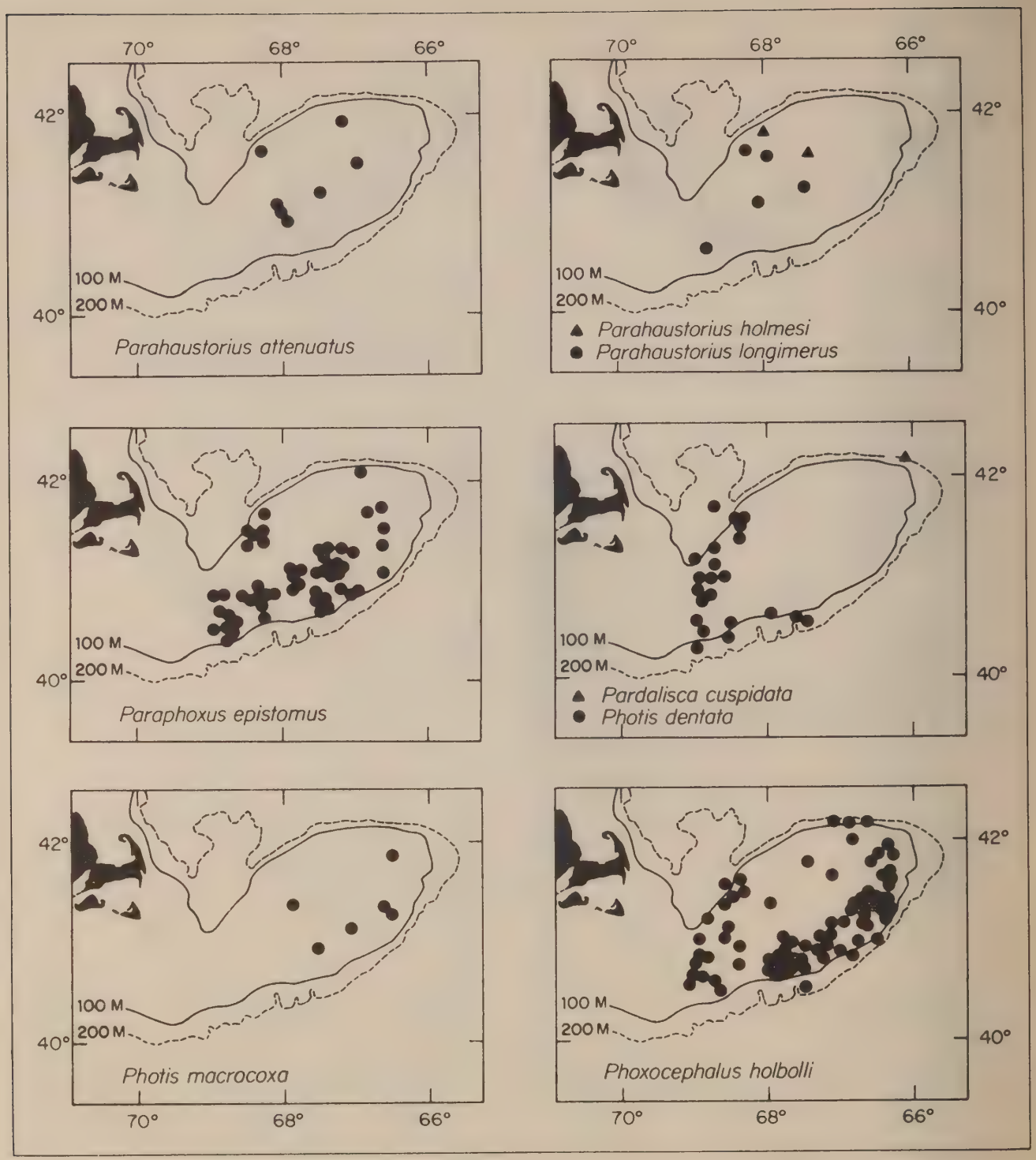

Figure 11.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

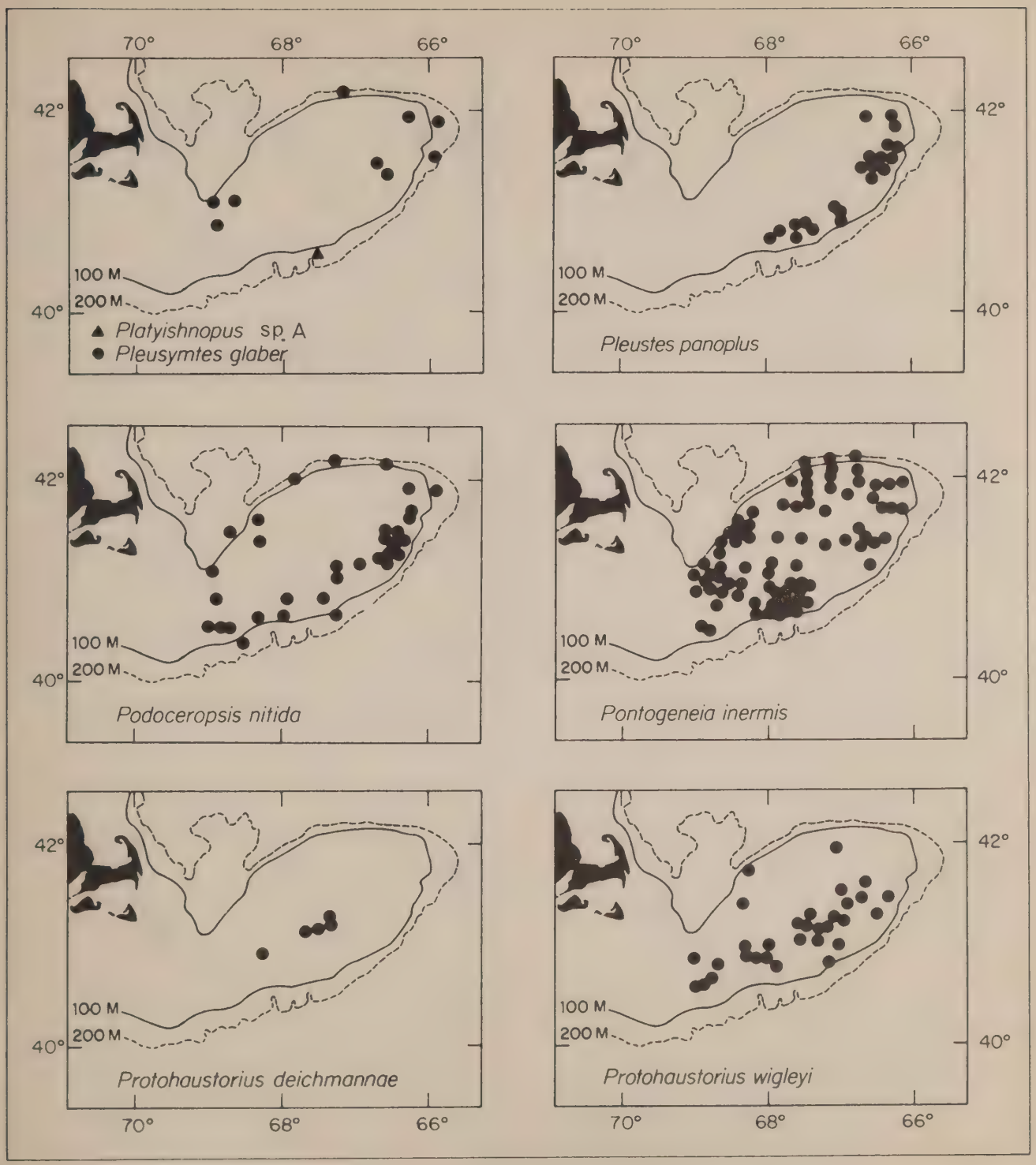

Figure 12.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

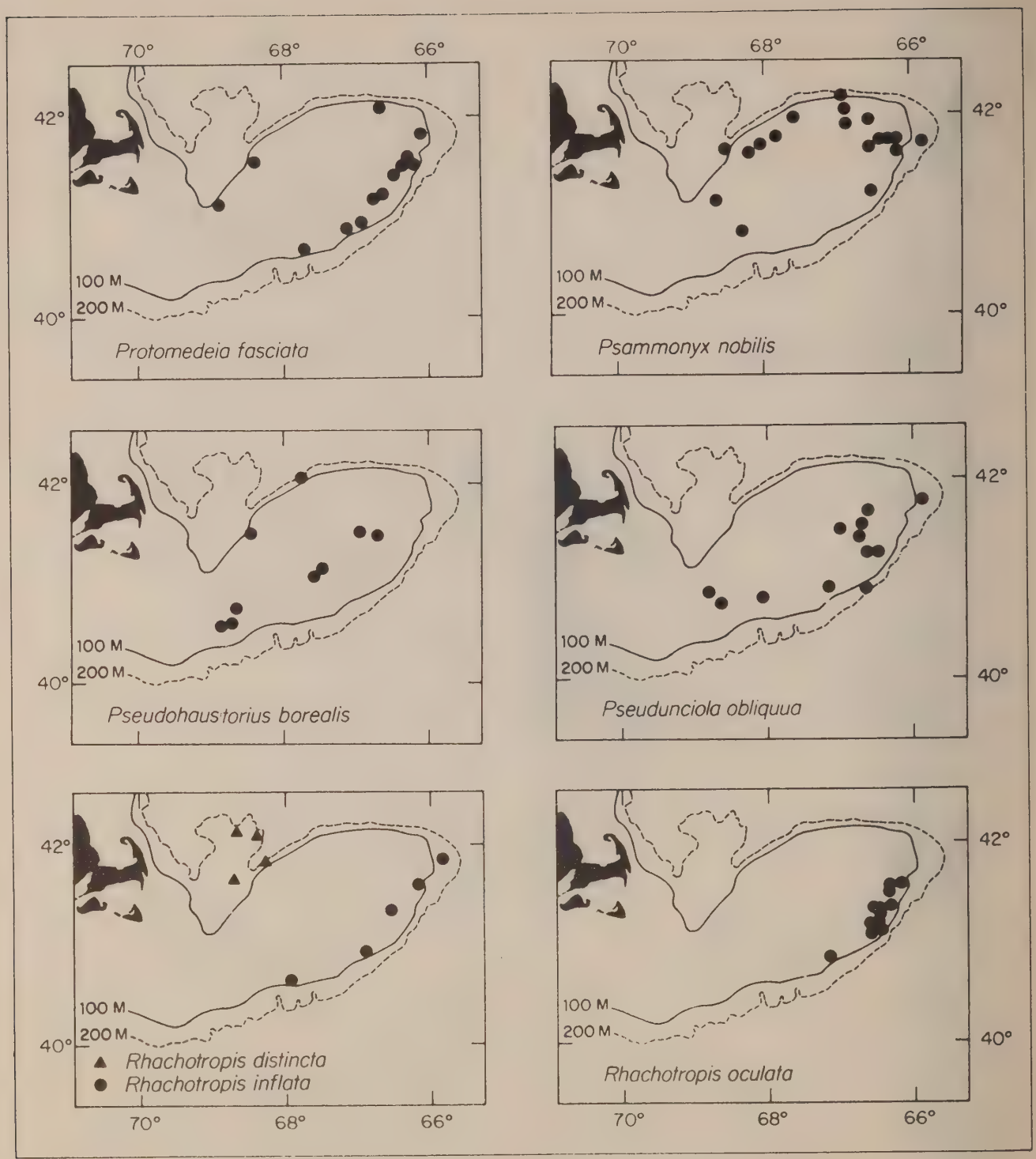

Figure 13.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

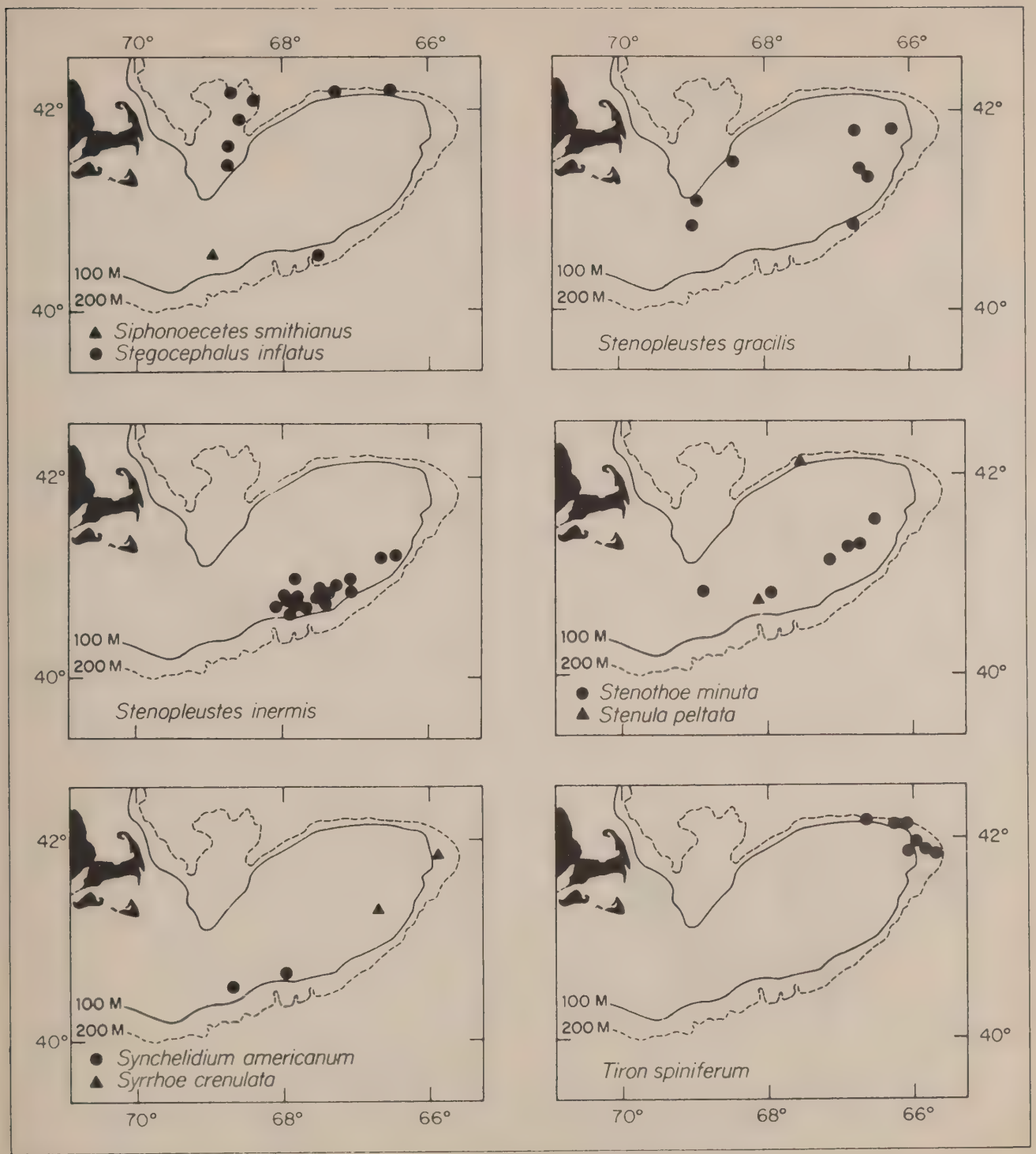

Figure 14.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

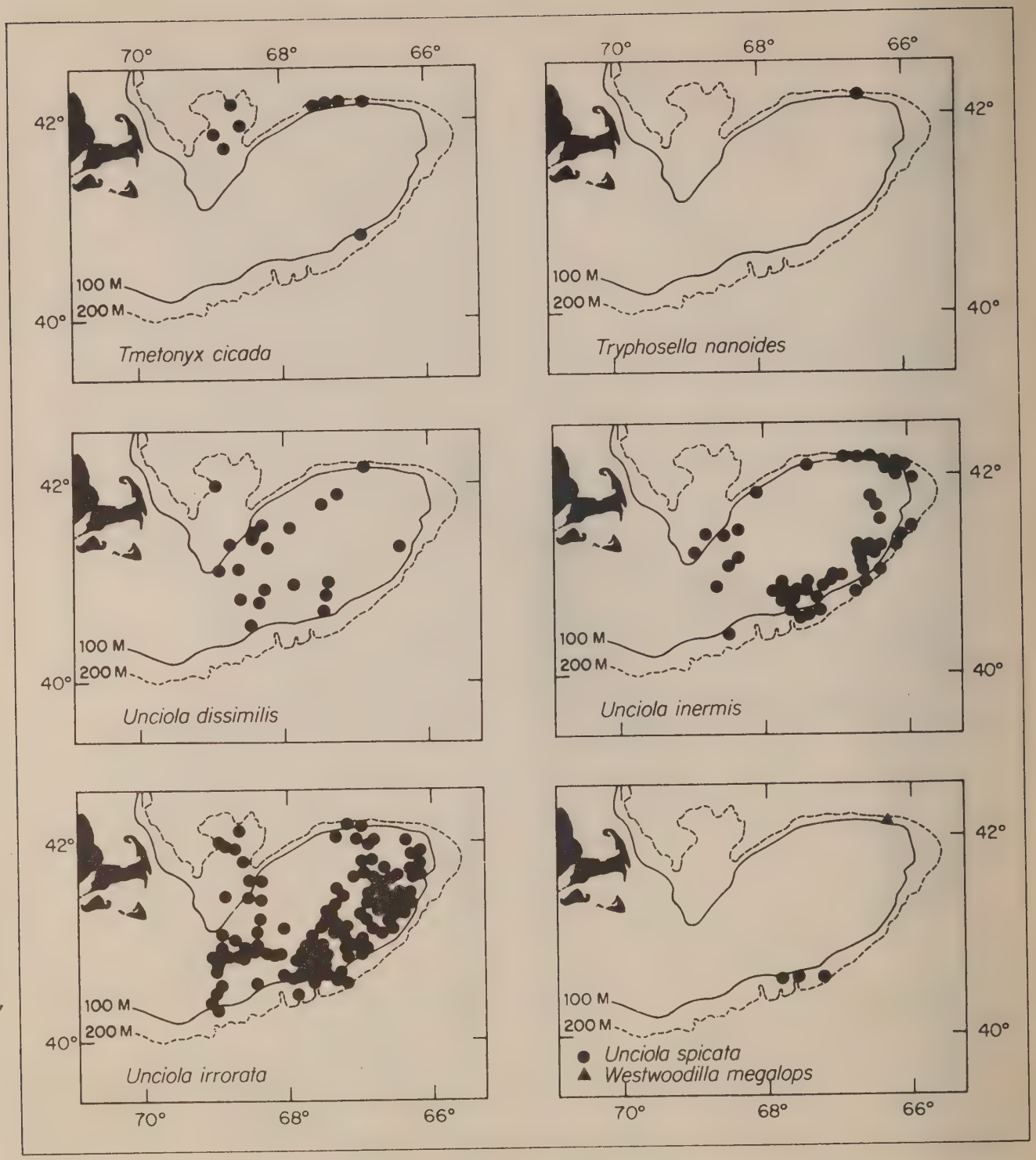

Figure 15.—Geographic distribution of species of gammaridean Amphipoda on Georges Bank.—Continued.

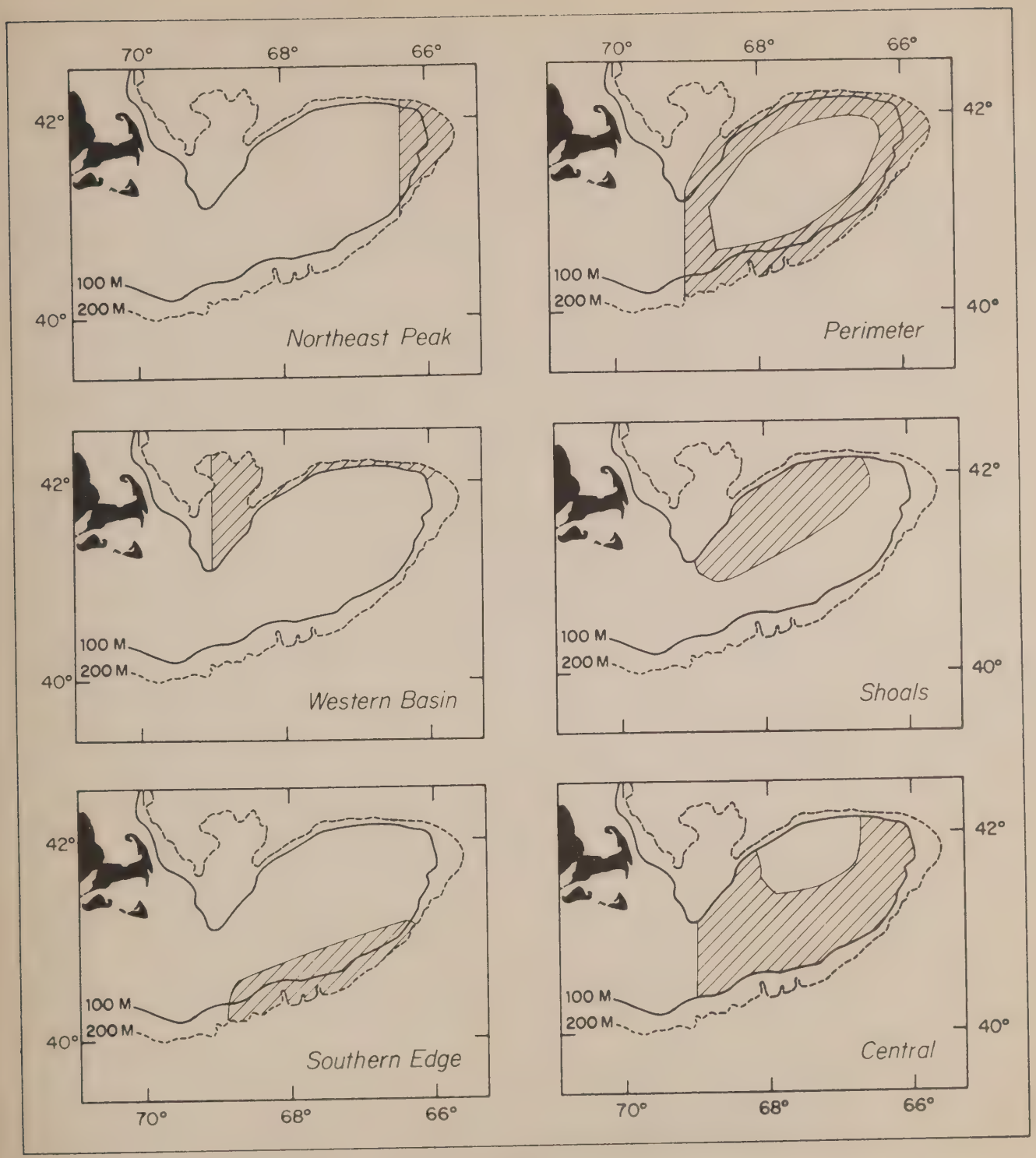

Figure 16.—Most common distribution patterns of gammarideans on Georges Bank.

NOAA TECHNICAL REPORTS
NMFS Circular and Special Scientific Report—Fisheries

Guidelines for Contributors

CONTENTS OF MANUSCRIPT

First page. Give the title (as concise as possible) of the paper and the author's name, and footnote the author's affiliation, mailing address, and ZIP code.

Contents. Contains the text headings and abbreviated figure legends and table headings. Dots should follow each entry and page numbers should be omitted.

Abstract. Not to exceed one double-spaced page. Footnotes and literature citations do not belong in the abstract.

Text. See also Form of the Manuscript below. Follow the *U.S. Government Printing Office Style Manual,* 1973 edition. Fish names, follow the American Fisheries Society Special Publication No. 6, *A List of Common and Scientific Names of Fishes from the United States and Canada,* third edition, 1970. Use short, brief, informative headings in place of "Materials and Methods."

Text footnotes. Type on a separate sheet from the text. For unpublished or some processed material, give author, year, title of manuscript, number of pages, and where it is filed—agency and its location.

Personal communications. Cite name in text and footnote. Cite in footnote: John J. Jones, Fishery Biologist, Scripps Institution of Oceanography, La Jolla, CA 92037, pers. commun. 21 May 1977.

Figures. Should be self-explanatory, not requiring reference to the text. All figures should be cited consecutively in the text and their placement, where first mentioned, indicated in the left-hand margin of the manuscript page. Photographs and line drawings should be of "professional" quality—clear and balanced, and can be reduced to 42 picas for page width or to 20 picas for a single-column width, but no more than 57 picas high. Photographs and line drawings should be printed on glossy paper—sharply focused, good contrast. Label each figure. DO NOT SEND original figures to the Scientific Editor; NMFS Scientific Publications Office will request these if they are needed.

Tables. Each table should start on a separate page and should be self-explanatory, not requiring reference to the text. Headings should be short but amply descriptive. Use only horizontal rules. Number table footnotes consecutively across the page from left to right in Arabic numerals; and to avoid confusion with powers, place them to the *left* of the numerals. If the original tables are typed in our format and are clean and legible, these tables will be reproduced as they are. In the text all tables should be cited consecutively and their placement, where first mentioned, indicated in the left-hand margin of the manuscript page.

Acknowledgments. Place at the end of text. Give credit only to those who gave exceptional contributions and *not* to those whose contributions are part of their normal duties.

Literature cited. In text as: Smith and Jones (1977) or (Smith and Jones 1977); if more than one author, list according to years (e.g., Smith 1936; Jones et al. 1975; Doe 1977). All papers referred to in the text should be listed alphabetically by the senior author's surname under the heading "Literature Cited"; only the author's surname and initials are required in the author line. The author is responsible for the accuracy of the literature citations. Abbreviations of names of periodicals and serials should conform to *Biological Abstracts List of Serials with Title Abbreviations.* Format, see recent SSRF or Circular.

Abbreviations and symbols. Common ones, such as mm, m, g, ml, mg, °C (for Celsius), %, ‰, etc., should be used. Abbreviate units of measures only when used with numerals; periods are rarely used in these abbreviations. But periods are used in et al., vs., e.g., i.e., Wash. (WA is used only with ZIP code), etc. Abbreviations are acceptable in tables and figures where there is lack of space.

Measurements. Should be given in metric units. Other equivalent units may be given in parentheses.

FORM OF THE MANUSCRIPT

Original of the manuscript should be typed double-spaced on white bond paper. Triple space above headings. Send good duplicated copies of manuscript rather than carbon copies. The sequence of the material should be:

FIRST PAGE
CONTENTS
ABSTRACT
TEXT
LITERATURE CITED
TEXT FOOTNOTES
APPENDIX
TABLES (provide headings, including "Table" and Arabic numeral, e.g., Table 1.--, Table 2.--, etc.)
LIST OF FIGURE LEGENDS (entire legend, including "Figure" and Arabic numeral, e.g., Figure 1.--, Figure 2.--, etc.)
FIGURES

ADDITIONAL INFORMATION

Send ribbon copy and two duplicated copies of the manuscript to:

Dr. Carl J. Sindermann, Scientific Editor
Northeast Fisheries Center Sandy Hook Laboratory
National Marine Fisheries Service, NOAA
Highlands, NJ 07732

Copies. Fifty copies will be supplied to the senior author and 100 to his organization free of charge.

UNITED STATES
DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SCIENTIFIC PUBLICATIONS STAFF
ROOM 336
1700 WESTLAKE AVENUE N.
SEATTLE, WA 98109

OFFICIAL BUSINESS

NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

The National Oceanic and Atmospheric Administration was established as part of the Department of Commerce on October 3, 1970. The mission responsibilities of NOAA are to assess the socioeconomic impact of natural and technological changes in the environment and to monitor and predict the state of the solid Earth, the oceans and their living resources, the atmosphere, and the space environment of the Earth.

The major components of NOAA regularly produce various types of scientific and technical information in the following kinds of publications:

PROFESSIONAL PAPERS — Important definitive research results, major techniques, and special investigations.

CONTRACT AND GRANT REPORTS — Reports prepared by contractors or grantees under NOAA sponsorship.

ATLAS — Presentation of analyzed data generally in the form of maps showing distribution of rainfall, chemical and physical conditions of oceans and atmosphere, distribution of fishes and marine mammals, ionospheric conditions, etc.

TECHNICAL SERVICE PUBLICATIONS — Reports containing data, observations, instructions, etc. A partial listing includes data serials; prediction and outlook periodicals; technical manuals, training papers, planning reports, and information serials; and miscellaneous technical publications.

TECHNICAL REPORTS — Journal quality with extensive details, mathematical developments, or data listings.

TECHNICAL MEMORANDUMS — Reports of preliminary, partial, or negative research or technology results, interim instructions, and the like.

Information on availability of NOAA publications can be obtained from:

ENVIRONMENTAL SCIENCE INFORMATION CENTER (D822)
ENVIRONMENTAL DATA AND INFORMATION SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

6009 Executive Boulevard
Rockville, MD 20852

☆ U. S. Government Printing Office: 1981—798-408